



GENETIC RESOURCES OF CUCURBITACEAE

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GENETIC RESOURCES OF CUCURBITACEAE

- a global report -

by

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CONTENTS

| | |
|---------|---|
| Preface | v |
|---------|---|

REPORT

| | |
|--|----|
| I. Historical, economical and nutritional aspects of Cucurbitaceae | 1 |
| II. Biological and agricultural aspects of the species | 1 |
| III. Origin, evolution and distribution | 5 |
| IV. Genetics and genetic improvement | 17 |
| V. Variability and genetic erosion | 21 |
| VI. Existing germplasm collections | 21 |
| VII. Priorities for collecting | 30 |
| VIII. Maintenance and conservation | 32 |
| IX. Evaluation and characterization | 34 |
| X. References | 36 |

APPENDICES

| | |
|---|----|
| I. Key characteristics differentiating the cultivated species | 41 |
| II. Genes of the Cucurbitaceae | 42 |
| III. Acronyms used in this report | 51 |
| IV. Descriptor lists for: | |
| <u>Cucurbita</u> | 53 |
| <u>Cucumis melo</u> | 72 |
| <u>Cucumis sativus</u> | 88 |

LIST OF TABLES

| | |
|---|-------|
| 1. Nutritive value of major Cucurbitaceae crops | 2-3 |
| 2. World production of major Cucurbitaceae crops | 4 |
| 3. Cultivated species of Cucurbitaceae of global interest | 7 |
| 4. Cultivated species of Cucurbitaceae of regional of local importance | 8-9 |
| 5. Wild <u>Cucurbita</u> species | 12-13 |
| 6. Wild <u>Cucumis</u> species | 14-15 |
| 7. Diversity and genetic erosion | 22-23 |
| 8. Germplasm collections of major world collections | 24-27 |
| 9. Current situation of major world collections | 28-29 |
| 10. Population size necessary for preserving non-fixed alleles in accession samples of cross-pollinated species, assuming random mating | 32 |

LIST OF ILLUSTRATIONS

| | |
|---|-------|
| 1. Variability among some species of <u>Cucurbita</u> cultivated throughout the world | 6 |
| 2. Variability within a single species, <u>Sechium edule</u> , cultivated throughout the tropics | 6 |
| 3. Primary centres of diversity for <u>Cucurbita</u> | 10 |
| 4. Primary centres of diversity of <u>Cucumis</u> and <u>Citrullus</u> | 11 |
| 5. Secondary centres of diversity of the globally important Cucurbitaceae | 11 |
| 6. Cultivated <u>Cucurbita</u> are among the most popular crops in Bolivia | 18 |
| 7. Interspecific crossability among cultivated <u>Cucurbita</u> spp. | 18 |
| 8. Interspecific crossability in wild <u>Cucurbita</u> | 19 |
| 9. Interspecific crossability in <u>Cucumis</u> | 20 |
| 10. Wild <u>Cucumis</u> from Africa | 20 |
| 11. A once-popular primitive landrace of melons (<u>Cucumis melo</u>) from Villaconejos, Spain which has today largely disappeared as a result of genetic erosion | 21 |
| 12. Collecting seeds of <u>Cucurbita</u> | 29 |
| 13. Glasshouses and screenhouses are often used to control pollination during multiplication of Cucurbitaceae | 34 |
| 14. Fruits of <u>Cucurbita</u> prepared for an evaluation study | 35 |
| 15. Root (left) and fruit, both of which are edible, of <u>Sechium edule</u> in a local market in Central America | 35 |
| 16. <u>Cucurbita</u> fruit shape | 57-59 |
| 17. Design produced by secondary skin colour in <u>Cucurbita</u> | 61 |
| 18. <u>Cucurbita</u> stem and fruit shape | 65 |
| 19. Blossom-end fruit shape in <u>Cucurbita</u> | 66 |
| 20. Fruit rib shape in <u>Cucurbita</u> | 66 |
| 21. <u>Cucumis melo</u> fruit shape | 76-77 |
| 22. Design produced by secondary skin colour in <u>Cucumis melo</u> | 79 |
| 23. <u>Cucumis sativus</u> fruit shape | 92-93 |
| 24. <u>Cucumis sativus</u> stem-end fruit shape | 96 |
| 25. <u>Cucumis sativus</u> blossom-end fruit shape | 97 |

Preface

Following a consultant report from the Royal Tropical Institute, Netherlands on vegetable germplasm of interest in the tropics, which was published in 1977, the IBPGR held an expert consultation in January 1979 at the National Vegetable Research Station, U.K. to define priorities. The consultation agreed on nine priority groups of vegetables. Cucurbits and Momordica were included among the high priority crops. The IBPGR endorsed the priorities and requested that a status report on the genetic resources of the species should be prepared.

In 1981 the IBPGR undertook an extensive revision of global and regional priorities during which it was agreed that the very high priority given to Momordica should be reduced somewhat.

The present report was endorsed by IBPGR at its ninth meeting in February 1983.

I. HISTORICAL, ECONOMICAL AND NUTRITIONAL ASPECTS OF CUCURBITACEAE

In the Cucurbitaceae family there are approximately 30 species of nine genera that are used as cultivated plants. These include squash, pumpkin, vegetable marrows, gourds, melons, watermelons, cucumber and several lesser known crops. They are used as fruits, vegetables, edible seed, oil seed, fodder and fibre.

Cucurbits were among the first plants used by man. The bottle gourd (Lagenaria siceraria) may be the only plant known in both the New and Old Worlds in early prehistoric times; archaeological evidence of man's association with Lagenaria in Peru dates from 11,000 to 13,000 years BC and evidence from the Spirit Cave in Thailand dates its use in Southeast Asia to between 10,000 and 6000 years BC. Species of Cucurbita were major crops in the agriculture of the Aztec, Inca and Mayan civilizations in Central and South America. Cucumbers have been cultivated in India for perhaps 3,000 years.

The nutritional values of the most widely cultivated species are shown in Table 1 (pp. 2-3). The most important contributions of the fruits are vitamins and minerals, especially vitamins A and C. Pumpkin and winter squash, which are much more important crops in developing countries than in developed countries, are the most nutritious cucurbit fruits. Winter squash is considered to be among the most efficient of vegetable crops when evaluated on nutritional yield, when considered against land area and labour needed. The seeds of several species are commonly eaten in Latin America, South, Southeast and East Asia and in Central Africa, and make important contributions to oil and protein in the diet. Seeds can have a protein content of 30-40% and a similar percentage oil content. The young leaves and flowers of several species are eaten, and are a very rich source of vitamins and minerals. Two species, chayote and buffalo gourd produce large starchy edible roots in addition to fruits.

The species of Cucurbitaceae grow throughout the world from the tropics to the temperate zones and there is a wide variety of use ranging from the nutritionally important pumpkin to the desert melon and glasshouse cucumber. The important cultivated species are major market crops in Latin America, North America, North Africa, Southern Europe and tropical and temperate Asia. In addition, there is also large commercial production of cucumbers in a number of more northern countries.

Statistics of worldwide production of the major crop species are shown in Table 2 (p. 4). These data are based on market production and overlook the fact that the species are important in subsistence farming; many kitchen gardens contain some plants from this family. The figures in Table 2 do not account for production for livestock feed.

II. BIOLOGICAL AND AGRICULTURAL ASPECTS OF THE SPECIES

The Cucurbitaceae family is characterized by long training viny stems. There is variation for flower size and colour among the species but they all have a similar general morphology.

The species are open pollinated and self-compatible. Most of them are either monoecious (e.g. Cucurbita spp.) or andromonoecious (e.g. common in melons). Other species show gynomonocy, androgynomonocy, androecy, gynoecy, hermaphrodite and dioecy. Mutants for male sterility are fairly common in some species and are frequently used in breeding.

Although all the species are killed by frost, they show varying degrees of sensitivity to ranges of temperature and humidity. Watermelons and melons grow better in hot dry climates and have disease problems in areas of high humidity. Cucumbers are also sensitive to high humidity and hence grow well in warm conditions, but not at temperatures as high as those tolerated by melons and watermelons. Among the cultivated

Table 1. Nutritive Value of Major Cucurbitaceae Crops (in 100 grams edible portion with comparison to milk and eggs)

| Crop | Edible part | % Refuse | Energy Calories | Water (gr) | Protein (gr) | Fat (gr) | CHO | VITAMINS | | | | | | MINERALS | | | | | |
|--|--------------|----------|-----------------|------------|--------------|----------|----------|----------|---------|---------|--------|-------|-------|------------|-------|-------|--|--|--|
| | | | | | | | | I.U. | | | | | | Milligrams | | | | | |
| | | | | | | | | A | B1 | B2 | Niacin | C | Ca | Fe | Mg | P | | | |
| Cucumber* (<i>Cucumis sativus</i>) | Immat. fruit | 15 | 12 | 96 | 0.6 | 0.1 | 2.2 | 45 | .03 | .02 | .3 | 12 | 12 | .3 | 15 | 24 | | | |
| Melons* (<i>Cucumis melo</i>) | Mature fruit | 41-45 | 26-41 | 87-92 | .6-1.0 | 0.1 | 6.3-10.3 | Tr.-4200 | .06 | .02 | 4-.9 | 19-45 | 5-10 | .2-.4 | 8-17 | 7-39 | | | |
| Watermelon* (<i>Citrullus</i>) | Mature fruit | 50 | 36 | 90 | 0.6 | 0.1 | 9.1 | 300 | .08 | .02 | .2 | 6 | 5 | .2 | 10 | 14 | | | |
| Watermelon** (<i>C. vulgaris</i>) | Seeds | 65 | 514 | 10 | 40 | 43 | 3.1 | .30 | .02 | .06 | 1.2 | Tr. | 54 | 5.6 | - | 444 | | | |
| Pumpkins & winter squash* (<i>Cucurbita</i> spp.) | Mature fruit | 15-40 | 20-40 | 85-91 | .8-2.0 | .1-.5 | 3.3-11.0 | 340-7800 | .07-.14 | .01-.04 | .5-1.2 | 6-21 | 14-48 | 7.0 | 16-34 | 21-38 | | | |
| (<i>Benincasa hispida</i>) | Mature fruit | 25 | 15** | 96 | .2 | .1 | 3.5** | Tr. | .02 | .03 | .5 | 14 | 14 | .4 | 16 | 7 | | | |
| Summer squash*** (<i>Cucurbita pepo</i>) | Immat. fruit | 1-5 | 13-22 | 92-95 | 1.0-1.4 | .1-.2 | 2-4 | 80-340 | .05-.07 | .03-.04 | .4-.6 | 9-19 | 15-19 | .5 | 20-26 | 28-38 | | | |
| (<i>Cinaxima</i>) | Leaves | 51 | 33 | 90 | 3.8 | .7 | 4.9 | 2400 | .12 | .18 | 1.1 | 19 | 159 | 1.6 | - | 99 | | | |
| (<i>Cinaxima</i>) | Flowers | 41 | 29 | 90 | 2.0 | .5 | 5.6 | 910 | .05 | .11 | .9 | 24 | 74 | 3.1 | - | 33 | | | |
| (<i>Luffa acutangula</i>) | Immat. fruit | 10 | 20 | 93 | 1.2 | .2 | 4.0 | 410 | .05 | .06 | .4 | 12 | 20 | .4 | - | 32 | | | |
| (<i>Benincasa hispida</i>) | Immat. fruit | 10 | 18 | 94 | 1.0 | .2 | 3.3 | 450 | .02 | .04 | .5 | 57 | 13 | .4 | - | 23 | | | |
| (<i>Luffa cylindrica</i>) | Immat. fruit | 29 | 21 | 94 | .6 | .2 | 4.9 | 45 | .04 | .02 | .3 | 7 | 16 | .6 | - | 24 | | | |
| Snake gourd** (<i>Trichosanthes</i>) | Immat. fruit | 14 | 16 | 95 | .6 | Tr. | 4.0 | 235 | .02 | .03 | .3 | 12 | 22 | .3 | - | 15 | | | |

Table 1. Nutritive Value of Major Cucurbitaceae Crops (in 100 grams edible portion with comparison to milk and eggs) (Cont.)

| Crop | Edible part | % Refuse | Energy Calories | Water (gr) | Protein (gr) | Fat (gr) | CHO | VITAMINS | | | | | | | MINERALS | | | | |
|--|--------------|----------|-----------------|------------|--------------|----------|-----|----------|-----|-----|--------|----|-----|-----|------------|-----|--|--|--|
| | | | | | | | | I.U. | | | | | | | Milligrams | | | | |
| | | | | | | | | A | B1 | B2 | Niacin | C | Ca | Fe | Mg | P | | | |
| Bottle gourd** (<i>Lagenaria siceraria</i>) | Immat. fruit | 16 | 15 | 95 | .5 | .1 | 3.5 | 10 | .04 | .02 | .4 | 11 | 16 | .4 | - | 14 | | | |
| Chayote** (<i>Sechium edule</i>) | Immat. fruit | 14 | 26 | 93 | .9 | .3 | 5.3 | 50 | .03 | .04 | .5 | 11 | 19 | .4 | 14 | 20 | | | |
| Chayote*** (<i>Sechium edule</i>) | Root | - | - | 72 | .1 | .1 | - | 0 | .07 | .07 | 1.1 | 21 | 4 | 1.0 | - | 84 | | | |
| Chayote** (<i>Sechium edule</i>) | Leaves | 70 | 34 | 93 | - | .2 | 6.4 | 3000 | .07 | .07 | .8 | 33 | 66 | .3 | - | 47 | | | |
| Eggs (hen)**** | Whole/raw | - | 162 | 74 | 12.8 | 11.5 | 0.7 | 1140 | .10 | .29 | .1 | 0 | 54 | 2.7 | - | 210 | | | |
| Milk (cow)**** | Pastur-ized | 0 | 68 | 87 | 3.5 | 3.9 | 4.9 | 160 | .04 | .17 | .1 | 1 | 118 | 1 | - | 93 | | | |
| Min. requirement/day: ***** 22 yrs., 68 kg. | | | 2800 | | 65 | | | 5000 | 1.4 | 1.7 | 18 | 60 | 800 | 10 | 350 | 800 | | | |

References

* Howard, F., MacGillivray, J.H. and Yamaguchi, M. 1962. Nutrient Composition of Fresh California Vegetables. Calif. Agric. Expt. Bull. 788. 43pp.
 ** Itengan, et al. 1964. Food Composition Tables Handbook 1, Food Res. Center, Manila, Philippines
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 **** Watt and Harill. 1950. Composition of Food. Agricultural Handbook 13. USDA.
 ***** Food and Nutrition Board. 1968. National Academy of Science, Washington.

Table 2. World Production of Major Cucurbitaceae Crops

| | Average production per year and area harvested | | | | | | | | | |
|-------------------------------------|--|----------------------|----------------|---------------------------|--|-------------------|----------------------|----------------|---------------------------|--|
| | 1969-71 | | | | | 1979-81 | | | | |
| | Watermelon | Cucumbers & Gherkins | Melons | Pumpkins, Squash & Gourds | | Watermelon | Cucumbers & Gherkins | Melons | Pumpkins, Squash & Gourds | |
| World total | 19.724* (1747)** | 8.418 (725) | 5.112 (419) | 4.599 (576) | | 25.264 (1.876) | 10.757 (817) | 6.550 (483) | 5,256 (539) | |
| Developed Countries | 4.383 (272) | 2.799 (146) | 2.191 (167) | 1.091 (62) | | 4.961 (249) | 3.410 (144) | 2.512 (168) | 1.167 (63) | |
| Centrally planned economy countries | 6.397 (735) | 4.333 (460) | 1.235 (84) | 1.250 (310) | | 8.053 (776) | 5.347 (508) | 2.722 (107) | 1.451 (222) | |
| Developing Countries | 8.943 (739) | 1.286 (119) | 1.685 (168) | 2.258 (204) | | 12.251 (845) | 2.001 (164) | 2.315 (208) | 2,638 (254) | |

* Numbers without brackets = Average production per year X 1 000 in Metric Tons.

** Numbers in brackets = Average area harvested per year X 1 000 in Ha.

species of Cucurbita, C. maxima is the most tolerant to cool temperatures; whereas C. pepo, C. moschata and C. mixta show intraspecific variation for tolerance to low temperatures.

Table 3 (p. 7) presents important features of a second group of Cucurbitaceae species that are cultivated as important crops throughout the tropical and temperate world. Among them Cucurbita is the only genus with several major cultivated species. Appendix I provides a list of key characteristics used for taxonomic differentiation among these species.

Table 4 (pp. 8-9) provides a non-exhaustive list of other cultivated species of Cucurbitaceae. It gives information on current knowledge and crop potentiality of these species. These are minor crops throughout the world and/or cultivated intensively in localized areas.

Wild species of Cucurbita and Cucumis are listed in Tables 5 and 6 respectively (pp. 12-15) with comments on their distribution biology and their potential value to the gene pool of cultivated cucurbits. Interspecific compatibility in these genera is discussed in Section V, Genetics and Genetic Improvement.

III. ORIGIN, EVOLUTION AND DISTRIBUTION

The cultivated species of Cucurbitaceae include plants of both New and Old World origin. Figures 3 and 4 (pp. 10-11) show the areas of origin and diversity of the genera Cucurbita, Cucumis and Citrullus. Table 4 provides information on the distribution of other cultivated species. Tables 5 and 6 give the areas of distribution of wild Cucurbita and Cucumis, respectively.

Current knowledge on the origin and evolution of the most significant species is summarized as follows:

A. Cucurbita (See Figure 3 for cultivated and Table 5 for wild species)

Cultivated Cucurbita originated in two centres in the New World: central Mexico is the centre of origin for Cucurbita pepo, C. moschata, C. mixta and possibly C. ficifolia and southern Peru, Bolivia and northern Argentina are the centres of origin for C. maxima.

In Mexico archaeological excavations of caves in Oaxaca show the association of C. pepo with man from as early as 8500 BC and the species is thought to have been cultivated by 4050 BC. The earliest findings for C. moschata and C. mixta in excavations of caves date from ca 5000 BC. From Mexico the crops spread both north and south: C. pepo spread to northern Mexico, and southern and eastern USA and was cultivated up to the Canadian border before European colonization; C. moschata and C. mixta spread north to the southwest of the USA and south to Central America; C. moschata was carried south into northern South America and was introduced to Peru as early as 3000 BC. There is evidence of C. ficifolia being used by man in Peru as early as 3000 BC.

For C. maxima, the only cultivated species originating in South America, there have been no archaeological findings of C. maxima north of Peru and the earliest discoveries in Peru date from 1800 years BC.

Today the area of diversity for C. pepo is mainly northern Mexico. That for C. mixta extends from central Mexico and the Yucatan peninsula to Costa Rica. The centre of diversity for C. moschata extends from Mexico City south through Central America into northern Colombia and Venezuela. C. ficifolia, a highland species growing at 1000-2000m, occurs from central Mexico through the high plateaux of Central America and along the Andes to central Chile. The southern species, C. maxima, is noted for its extremely rich diversity and some authors suggest that it has more cultivated forms than any other cultivated plant. Its centre of diversity is in northern Argentina, Bolivia, southern Peru and northern Chile.

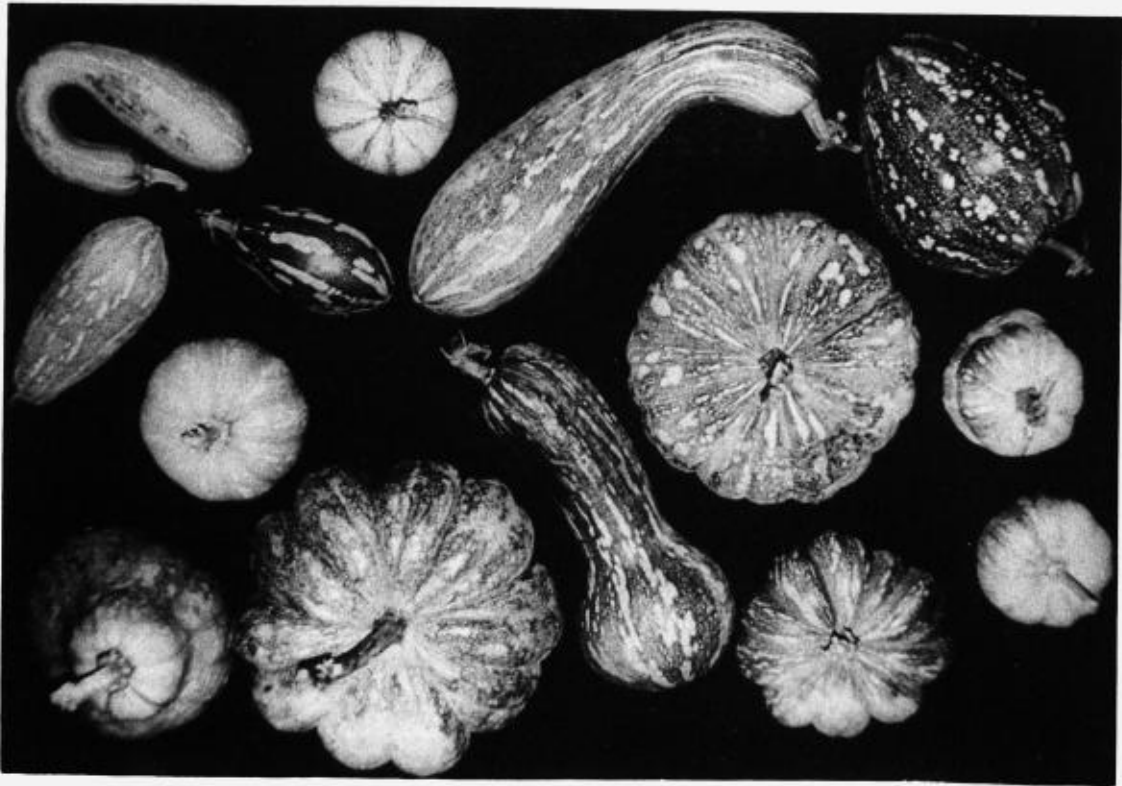


Figure 1. Variability among some species of Cucurbita cultivated throughout the world

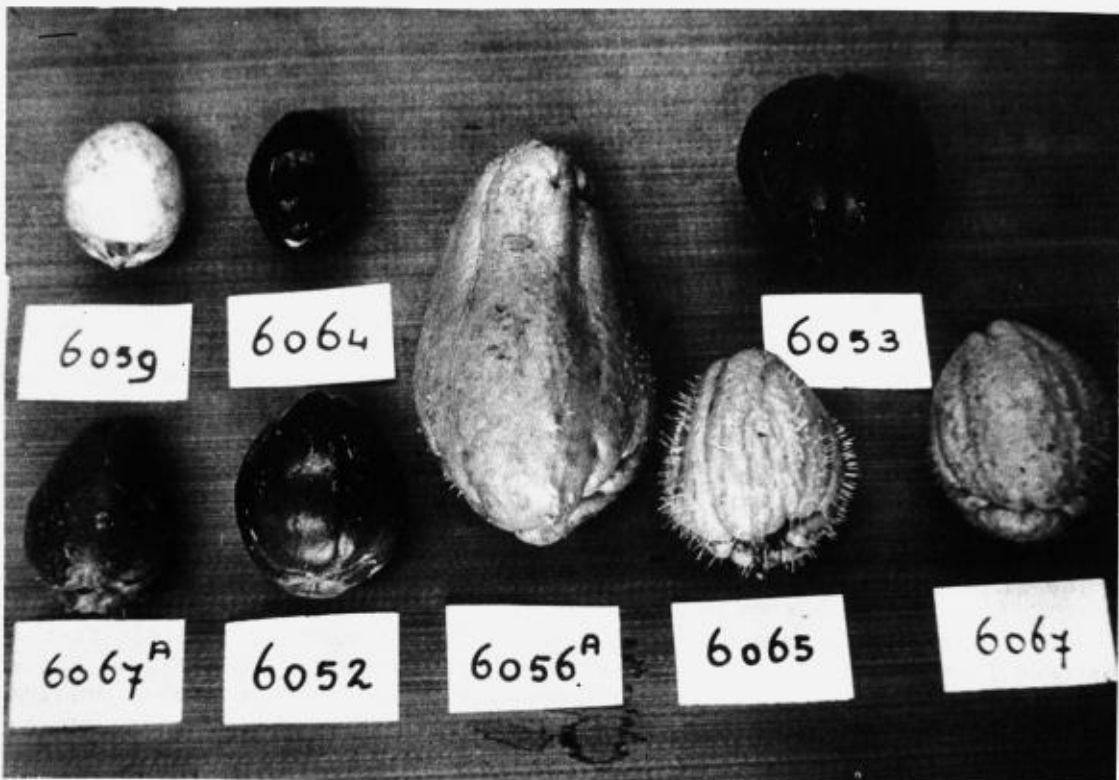


Figure 2. Variability within a single species, Sechium edule, cultivated throughout the tropics

Table 3. Cultivated Species of Cucurbitaceae of Global Interest

| Scientific and common name | Uses | Lowland (L) or High- land (H) habit* | Annual (A) or Peren- nial (P) habit | Chromo- some number |
|--|--|---|--|---------------------------|
| <u>Citrullus lanatus</u> (Thumb.) Matsum. & Nakai Watermelon | Mature fruits as fruits and fodder; edible seeds | L | A | 22 |
| <u>Cucumis melo</u> L. Melon | Mature fruits as fruits and as vegetables; edible seeds | L | A | 24 |
| <u>Cucumis sativus</u> L. Cucumber | Immature fruits as vegetables and as pickles; leaves as vegetables | L | A | 14 |
| <u>Cucurbita maxima</u> Duch. ex Lam. Pumpkin, Winter squash | Mature fruits, flowers and leaves as vegeta- bles; edible seeds; mature fruits as fodder | L | A | 40 |
| <u>Cucurbita mixta</u> Pang. Pumpkin, Winter squash, Cushaw | Mature fruits, flowers and leaves as vegeta- bles; edible seeds; mature fruits as fodder | L | A | 40 |
| <u>Cucurbita moschata</u> (Duch. ex Lam.) Duch ex Poir. Pumpkin, Winter squash | Mature fruits, flowers and leaves as vegeta- bles; edible seeds; mature fruits as fodder | L | A | 40 |
| <u>Cucurbita pepo</u> L. Summer squash, Winter squash, Pumpkin, Gourd | Mature and immature fruits, flowers, leaves as vegetables; edible seeds; mature fruits as fodder | L | A | 40 |

* Demarcation at 1,000 m

Table 4. Cultivated Species of Cucurbitaceae of Regional or Local Importance

| Scientific/common name(s) | Geographic areas of distribution | Uses | Lowland (L) or Highland (H)* | Annual (A)/Perennial (P) | Chromosome number | Comments |
|--|--|---|------------------------------|--------------------------|-------------------|--|
| <i>Benincasa hispida</i> (Thumb.) Cogn. Wax or white gourd | Throughout tropical Asia | Young and mature fruits; young leaves & buds as vegetable; seeds | L | A | 24 | Fruits have long-term storage capacity; potential crop for tropical Africa and Americas |
| <i>Citrullus colocynthis</i> (L.) Schrad. Colocynth | Tropical Africa | Seeds are eaten and used to make flour and cooking oil | - | A/P | 22 | Potential crops for arid lands; cross readily with <i>C. lanatus</i> |
| <i>Coccinia indica</i> Wight & Arn. Little gourd | Tropical Asia and Africa | Fruits and young shoots as vegetables | L | - | | |
| <i>Cucumeropsis mannii</i> Naud. Egusi melon | Tropical Africa | Edible oil seeds; fruits for fodder | L | A | 22 | Potential crop for tropical Asia and Americas |
| <i>Cucumis anguria</i> L. West Indian gherkin | Brazil West Indies | Young fruits as vegetables; pickles | L | A | 24 | Extraordinarily numerous fruits; has potential for wider use in gherkin production (i.e. small pickled fruits) |
| <i>Cucurbita ficifolia</i> Bouché Fig leaf or Malabar gourd | From Central Mexico to Chile | Mature fruits candied; edible seeds; as root-stock for watermelon and cucumber | H | P | 40 | Fruits have long-term storage capacity; potential for wide use in high-altitude cultivation; usually grown as annual |
| <i>Cucurbita foetidissima</i> H.B.K. Buffalo gourd | Wild in arid areas of southwest USA and northern to central Mexico | Oil and protein-rich seeds and fleshy starch containing roots, vines as forages | L | A** | 2/0 | Being developed as an arid region crop (Bemis, 1978) |
| <i>Cyclanthera pedata</i> (L.) Schrad. | In Andean countries of Latin America | Fruits as vegetables | H | A/P | 32 | Relatively productive; Potential for wide use in high-altitude cultivation |
| <i>Hodgsonia macrocarpa</i> (Bl.) Cogn. Chinese lard fruit | South and Southeast Asia | Fruits as vegetables and seeds for cooking oil production | - | - | - | Potential for wider cultivation as oil crops |
| <i>Lagenaria siceraria</i> Mol. Standl. Bottle gourd | Throughout all tropical, subtropical areas, especially Africa | Hard shell of dried mature fruits as containers, floats, musical instruments; immature fruits, young shoots of leaves as vegetables | L | A | 22 | - |
| <i>Luffa acutangula</i> (L.) Roxb. Angled loofa | Throughout India and East Asia | Young fruits as vegetables | L | A | 26 | - |

Table 4. Cultivated Species of Cucurbitaceae of Regional or Local Importance (Cont.)

| Scientific/common name(s) | Geographic areas of distribution | Uses | Lowland (L) or Highland (H)* | Annual (A)/Perennial (P) | Chromosome number | Comments |
|--|---|---|------------------------------|--------------------------|-------------------|--|
| <u>Luffa cylindrica</u> M.J. Roem. Smooth loofa | Tropics throughout the world, especially Japan and Brazil | Young fruits as vegetables; mature fruits for fibre | L | A | 26 | - |
| <u>Momordica charantia</u> L. Bitter gourd | Widespread throughout tropics, especially in South and Southeast Asia | Young fruits, leaves and shoots as vegetables; seed mass as condiment | L | A | 22 | - |
| <u>Momordica dioica</u> Roxb. ex Willd. Bitterless bitter gourd | Tropical Asia and Africa | Fruits, shoots and leaves as vegetables | L | - | 28 | - |
| <u>Potokowikia tacaco</u> | Central America | Young fruits as vegetables | L/H | P | - | - |
| <u>Praecitrullus fistulosus</u> Pang. | Northwest India | Fruits as vegetables | L | - | - | Fruits are noted for high nutritional value; potential for cultivation in Southeast Asia |
| <u>Sechium edule</u> (Jacq.) Sw. Chayote | Throughout tropics, especially Latin America | Young fruits and tuberous roots as vegetable leaves | H | P | 24 | - |
| <u>Sicara odorifera</u> (Vell.) Naud. Casabanana | Central America and northern South America | Fruits as fruit | L | - | - | - |
| <u>Telfairia occidentalis</u> Hook. F. Fluted gourd | Tropical Africa | Leaves and shoots as vegetable and edible seeds; stem fibres are used for cords | - | - | - | Adaptation to cultivation in humid tropics |
| <u>Telfairia pedata</u> (Sm. ex Sims) Hook. Oysternut | Tropical Africa | Large flavourful seeds | - | P | - | Potential substitute for almonds or Brazil nuts |
| <u>Trichosanthes cucumerina</u> L. Snake gourd | South and Southeast Asia | Immature fruit, shoots; leaves as vegetables | L | A | 22 | - |
| <u>Trichosanthes dioica</u> Roxb. Pointed gourd | Karnataka and West Bengal in India | Fruits as vegetables | L | - | 33 | - |

* Demarcation at 1,000 m.

** C. foetidissima regrows from its perennial roots and does not necessitate replanting.

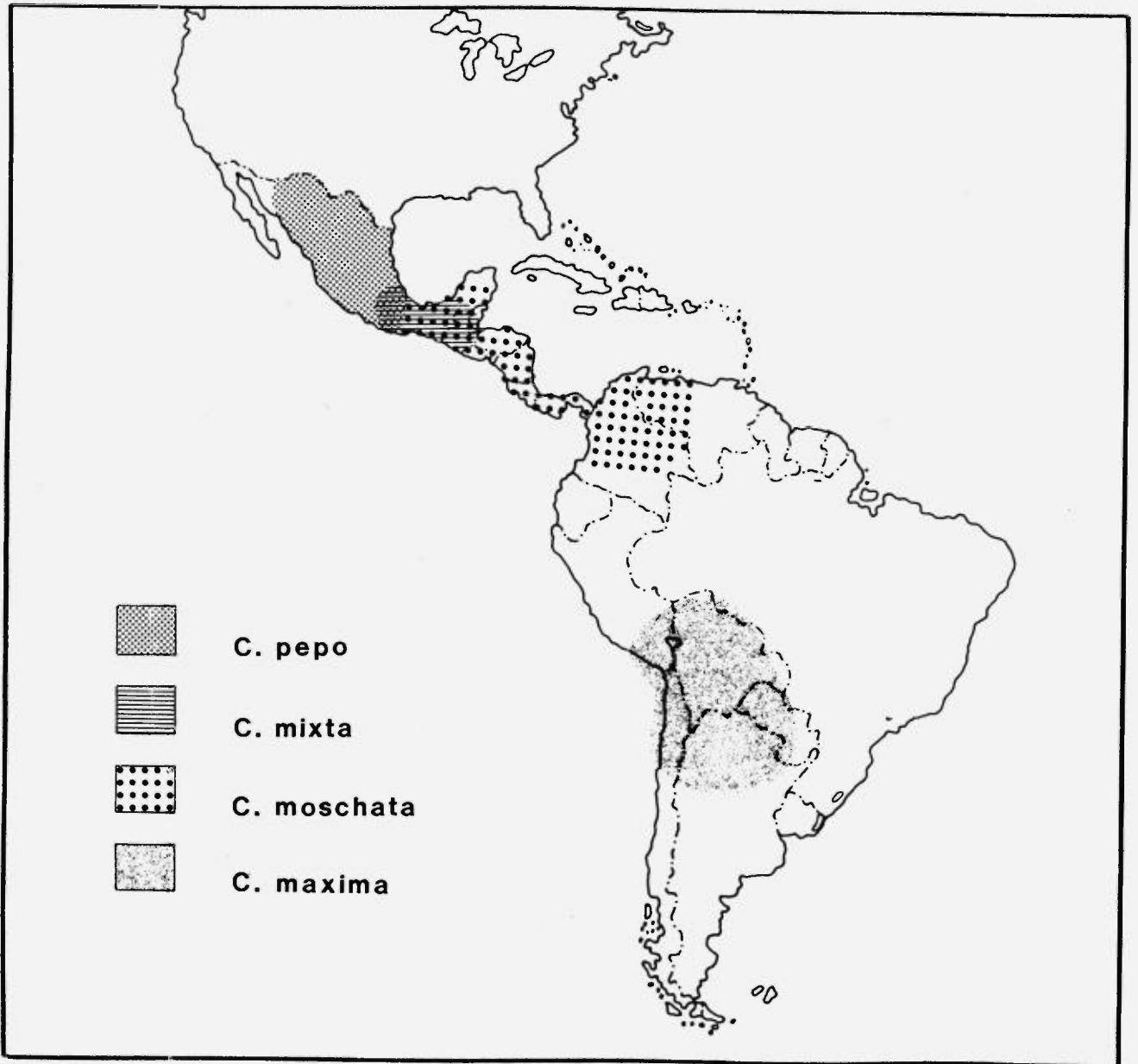


Figure 3. Primary centres of diversity of cultivated Cucurbita

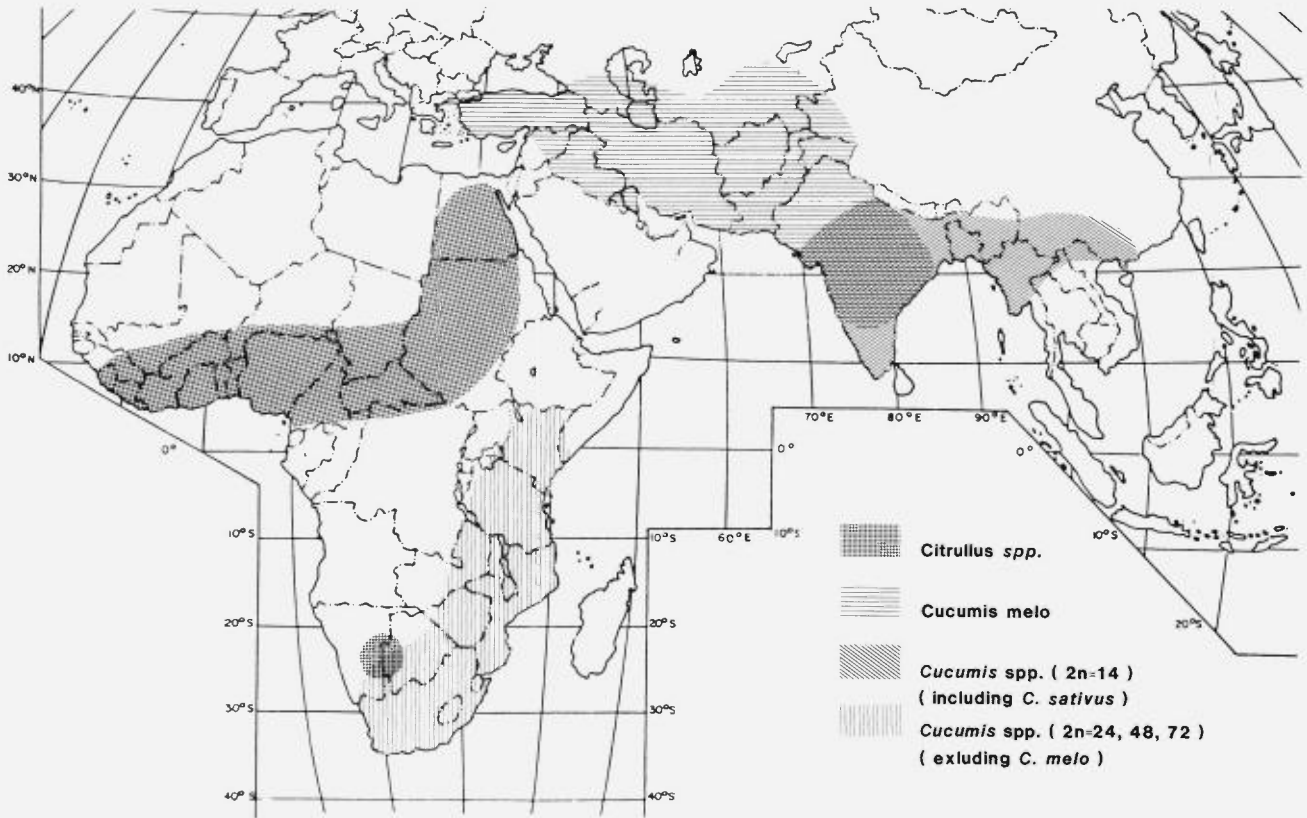


Figure 4. Primary centres of diversity of *Cucumis* and *Citrullus*

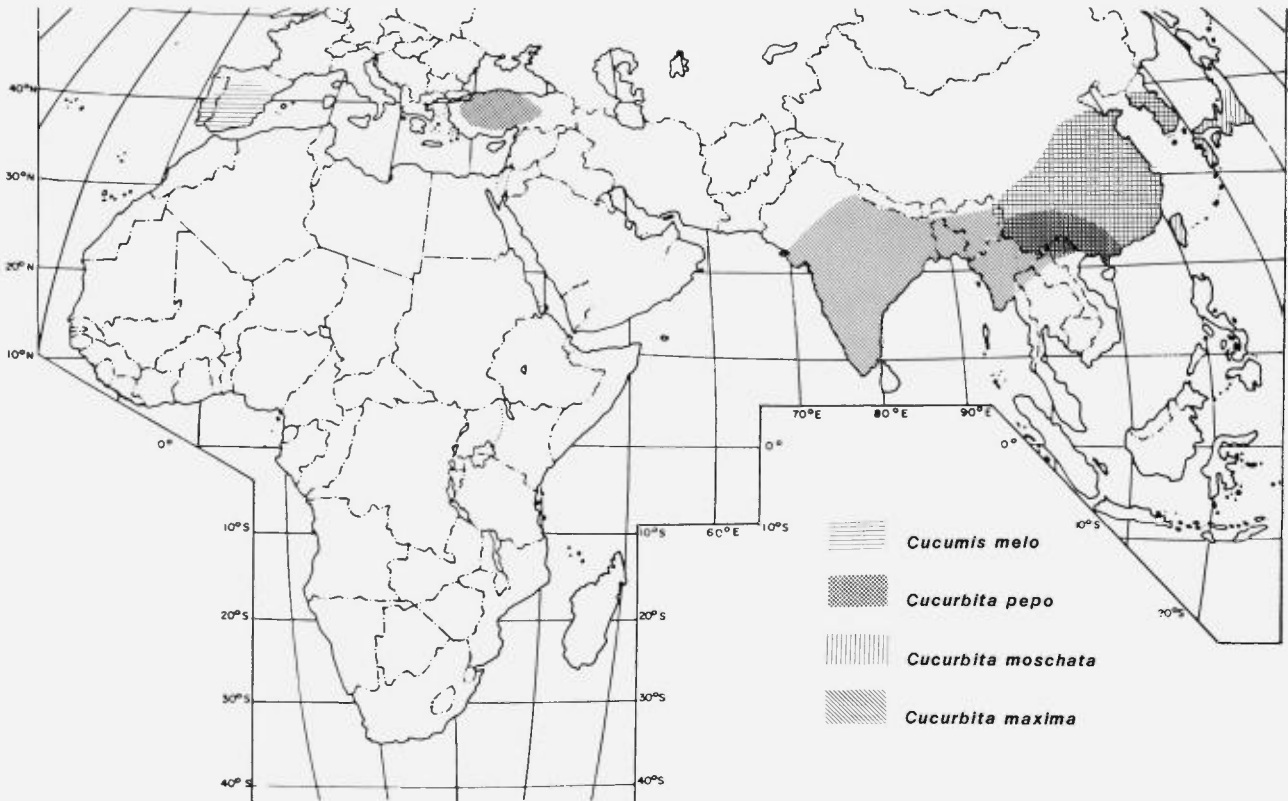


Figure 5. Secondary centres of diversity of globally important Cucurbitaceae

Table 5 - Wild Cucurbita Species *

| Species | Natural major area of distribution ** | Habitat *** | Longevity in its habitat **** | Comments |
|---------------------------------|---|-------------|-------------------------------|--|
| <u>Cucurbita andreana</u> Naud. | Argentina | M | A | Grows as weed along roadsides |
| <u>C. californica</u> Torr. | USA (Southern California, Arizona) | X | P | Its habitat is being destroyed by agriculture |
| <u>C. cordata</u> Wats. | Mexico (Baja California) | X | P | --- |
| <u>C. cylindrata</u> | Mexico (Baja California) | X | P | --- |
| <u>C. digitata</u> Gr. | USA (New Mexico, Arizona), Mexico (Baja California) | X | P | Its habitat is being destroyed by agriculture |
| <u>C. foetidissima</u> H.B.K. | USA (Nebraska, Kansas, Colorado, Utah, Nevada, Texas, Arizona, Missouri, New Mexico, California), Mexico (Guanajuato) | X | P | Very drought resistant; grows in disturbed areas as a weed; potential crop |
| <u>C. fraterna</u> Bailey | Mexico (Tamaulipas) | M | A? | --- |
| <u>C. galeotti</u> Cogn. | Mexico (Oaxaca) | X? | P? | --- |
| <u>C. gracilor</u> Bailey | Mexico (Mexico State) | M? | P? | --- |
| <u>C. kellyana</u> Bailey | Mexico (Jalisco) | M | A | --- |
| <u>C. lundelliana</u> Bailey | Guatemala, Belize | M | P | Very resistant to powdery mildew |
| <u>C. martinezii</u> Bailey | Mexico (Veracruz) | M | A | Very resistant to powdery mildew and squash and watermelon virus |
| <u>C. mooreii</u> Bailey | Mexico (Hidalgo) | M | A | --- |

Table 5. Wild Cucurbita Species * (Cont.)

| Species | Natural major area of distribution ** | Habitat *** | Longevity in its habitat **** | Comments |
|------------------------------------|--|-------------|-------------------------------|---|
| <u>C. okeechobeensis</u> Bailey | USA (Florida) | M | A | Its habitat has been destroyed by agriculture; very resistant to powdery mildew; it has been largely eliminated |
| <u>C. palmata</u> Wats. | USA (Southern California) | X | P | Its habitat is being destroyed by agriculture |
| <u>C. palmeri</u> Bailey | Mexico (Culiacan, Sinaloa) | X? | P? | Its habitat is being destroyed by agriculture |
| <u>C. pedatifolia</u> Bailey | Mexico (Quaretarao) | M | P? | It may be a bridge species between xerophytic and mesophytic crops |
| <u>C. radicans</u> Naud. | Mexico (around Mexico City) | M | P | --- |
| <u>C. scabridifolia</u> Bailey | Mexico (northeastern Mexico and southern Tamaulipas) | X | P | --- |
| <u>C. sororia</u> Bailey | Mexico (Guerrero, Oaxaca) | M | A | --- |
| <u>C. texana</u> A. Gray | USA (Central Texas) | M | A | Its habitat is being destroyed by agriculture |

* These are all lowland, monoecious, self-compatible and open-pollinated species with a basic chromosome number of $n = 20$

** Names in parentheses are areas where the species has been found and collected, but the area of distribution may be more extensive within the country

*** M = Mesophytic; X = Xerophytic

**** A = Annual; P = Perennial

Table 6. Wild Cucumis Species

| Species | Natural major area of distribution | Longevity (in its habitat)* | Sex type ** | Chromosome number | Comments |
|--|------------------------------------|-----------------------------|-------------|-------------------|--|
| <u>Cucumis africanus</u> Lindley F. | South Africa | A | M | 24 | Carries resistance to green mottle virus and bean spider mite |
| <u>C. asper</u> Cogn. | Southwest Africa | P | D | 24 | Carries resistance to white fly |
| <u>C. dinteri</u> Cogn. | Southwest Africa | | M | 24 | Carries resistance to white fly |
| <u>C. dipsaceus</u> Ehrenb.ex Spack | Ethiopia | A | M | 24 | Carries resistance to white fly |
| <u>C. ficifolius</u> A. Rich | Southeast Africa | P | M | 24,48, 72? | Carries resistance to green mottle virus; some resistance to nematode diseases |
| <u>C. figarei</u> Delille | Tropical Africa | P | D | 24 | --- |
| <u>C. hardwickii</u> Royle | India | A | M | 14 | Carries resistance to green mottle virus; some resistance to nematode diseases |
| <u>C. hirsutus</u> Sond. | Southwest Africa | P | D | 24 | --- |
| <u>C. heptadacylus</u> Naud. | South Africa | P | D | 48 | Carries resistance to green mottle virus; some resistance to nematode diseases |
| <u>C. hookeri</u> Naud. | South Africa | P | M | 24,48? | Carries resistance to green mottle virus; some resistance to nematode diseases |
| <u>C. humifructus</u> Stent. | South Africa | A | M | - | Underground fruiting |
| <u>C. kalahariensis</u> A. Meeuse | Southwest Africa | P | D | - | --- |

Table 6. Wild Cucumis Species (Cont.)

| Species | Natural major area of distribution | Longevity (in its habitat)* | Sex type ** | Chromosome number | Comments |
|---|------------------------------------|-----------------------------|-------------|-------------------|---|
| <u>C. leptodermis</u> Schweik. | South Africa | A | M | 24 | --- |
| <u>C. longipes</u> *** Hook. | Zimbabwe | A | M | 24 | Carries resistance to green mottle virus and bean spider mite; some resistance to nematode diseases |
| <u>C. membranifolium</u> | Ethiopia | - | M | 48 | --- |
| <u>C. metuliferus</u> E. Mey ex Schrad. | Southwest Africa | A | M | 24 | Some resistance to nematode diseases |
| <u>C. meeusii</u> C. Jeffrey | Southeast Africa | P | ? | 24 | --- |
| <u>C. myriocarpus</u> Naud. | Southwest Africa | A | M | 24 | Carries resistance to green mottled virus and bean spider mite |
| <u>C. prophetarum</u> L. | Sudan, Egypt | P | M | 24,48 | --- |
| <u>C. pustulatus</u> Hook. | Southeast Africa | P | M | 24,48 | --- |
| <u>C. quintanilhae</u> R. & A. Fernandes | Southeast Africa | P | M | - | --- |
| <u>C. sacleuxii</u> Paill and Bois | Southeast Africa | P | M | - | --- |
| <u>C. sagittatus</u> Peyr. | Southwest Africa | - | M | 24 | Carries resistance to white fly |
| <u>C. zeyheri</u> Sond. | South Africa | P | M | 24,48? | --- |

* A = Annual P = Perennial

** M = Monoecious; D = Dioecious

*** C. longipes is presently considered a wild C. anguria

After European contact with the Americas, Cucurbita species were introduced into the Old World and secondary centres of diversity developed. There is a secondary centre for C. pepo in central and Southern Turkey. India and Burma are a secondary centre for C. maxima and China and Japan are a secondary centre for C. moschata.

B. Cucumis (See Figure 4, p. 11, and Table 6, pp. 14-15)

The centre of origin for melon (Cucumis melo) is still not clear although the evidence points to Africa where wild species of Cucumis with the same basic chromosome number $n=12$ ($2n=24, 48, \text{ or } 72$) frequently occur. However, domestication may have occurred independently in Southeast Asia, India and East Asia. Today the primary centre of diversity for this extremely polymorphic species is in Southwest and Central Asia, mainly Turkey, Syria, Iran, Afghanistan, North and Central India and Transcaucasia, Turkmenistan, Tadjikistan and Uzbekistan. There is also secondary centres of diversity in China and the Republic of Korea and in the Iberian Peninsula.

Cucumber (Cucumis sativus) is thought to have originated in India where its wild relatives of chromosome number $2n=14$ are presently found. Perhaps it has been cultivated there for as long as 3,000 years. Cucumbers have also been cultivated in the Mediterranean region since the time of the ancient Greek and Roman civilizations.

For many years gherkin (C. anguria) was thought to be of American origin, but sexual compatibility and electrophoretic studies have shown that it is a cultigen which descended from a non-bitter mutant of a bitter African species, C. longipes.

C. Citrullus (see Figure 4, p. 11)

Watermelon (Citrullus lanatus) originated in Africa and wild forms of Citrullus occur in semi-desert areas. It was probably introduced into cultivation in Egypt and spread to India in very early times. The centres of diversity of cultivated forms are in India and in tropical and subtropical Africa.

D. Other genera (see Table 4, pp. 8-9)

The centre of origin and diversity for wax or white gourd (Benincasa hispida) is Southeast Asia and Indochina. It is known to have been used as a vegetable in China as early as 500 years AD.

Bottle gourd (Lagenaria siceraria) does not have a clear centre of origin. Archaeological findings show that it was present in Peru around 12,000 years BC, in Thailand around 8000 years BC, in Zambia around 2000 years BC and in Egypt it was used during the 12th Dynasty.

The probable centre of origin and the primary gene centre for Luffa is in India.

The bitter gourd (Momordica charantia) originated in the tropics of the Old World and has now been introduced throughout the tropical world. It is most likely that cultivation started in India although a number of related wild forms exist in Africa. It shows highest diversity in India, China and Southeast Asia. There are also a number of species in Indochina at present which are not well understood.

The centres of origin and diversity for chayote (Sechium edule) are in southern Mexico, Guatemala, Colombia and possibly the central Peruvian coast.

The centre of diversity for snake gourd (Trichosanthes cucumerina) extends from India to Australia.

The origin and diversity for all other minor species listed in Table 4 are to be found in their present areas of cultivation as reported in the table.

IV. GENETICS AND GENETIC IMPROVEMENT

Appendix II shows a comprehensive list of known genes of the major cultivated species of this family and provides an insight into their genetic variation and gives useful information on pest and disease resistances and other breeding characters.

The genetics of sex expression and its modification by growth regulators has been most comprehensively studied and exploited in cucumber (Cucumis sativus). Gynoecious lines of cucumber are widely used for the commercial production of F₁ hybrid seed. Detailed work on insect resistance and low temperature adaptation has been undertaken and current interest lies in interspecific crosses C. sativus x C. harwickii to produce cultivars with increased number of fruits per plant.

There has also been a great deal of work on disease resistance with melons (Cucumis melo). In addition to the genes indicated in Appendix II, researchers have found resistance to cucumber mosaic, melon mosaic and watermelon mosaic viruses and to downy mildew (Pseudoperonospora cubensis). Work is currently in progress on insect resistance, development of compact cultivars and regulation of sex expression.

In watermelon (Citrullus lanatus), in addition to work on disease and insect resistance there has been a great deal of research on the production of triploid seedless fruits.

There is current interest within the genera Cucurbita and Cucumis to produce interspecific hybrids for the transfer of disease and insect resistance, high and low temperature tolerance and drought tolerance (Tables 5 and 6). There is also considerable work being done on the domestication of wild species.

Interspecific Hybridization

There is a wide range of compatibility in interspecific crosses within some genera. Such compatibility relationships are important in breeding for the exchange of genes between species or when germplasm samples are grown for seed increase, to avoid pollen contamination.

Among the five cultivated species of Cucurbita, "there is no evidence for spontaneous hybridization between any of these species. In spite of the fact that many competent observers have searched for hybrids over a period of many years, none have been reported" (Whitaker, 1961).

A certain degree of cross-compatibility has been demonstrated among the Cucurbita through hand pollination. Although there is genetic variability within the species for interspecific compatibility, the most compatible crosses produce only slightly fertile F₁ hybrids^{1/} and self-sterile F₂ progeny. Backcrossing is the current method used for gene transfer. The compatibility relationship of the cultivated Cucurbita are summarized in Figure 7 (p. 18). Crossability diagrams for wild Cucurbita and for Cucumis species are shown in Figures 8 and 9 respectively (pp. 19 and 20). These diagrams show the possibility of interspecific gene exchange and not necessarily phylogenetic relationships since neither the techniques used nor the efforts made to obtain crosses were the same in all cases. For instance, considerable effort has been required to achieve the cross C. melo x C. sativus and it is only rarely repeated. Gene exchange between two incompatible species might become possible via a third one acting as a bridge. This is the case for Cucumis melo and C. africanus through C. metuliferus; an even more interesting example is provided by C. heptadactylus that, although incompatible with either C. myriocarpus or C. anguria, is reported to cross readily with the hybrid between them (Figure 9).

^{1/} The F₁ hybrid between C. maxima and C. moschata shows heterosis and a high degree of resistance to diseases and low temperature. It is used as root stock for cucumber and watermelon in Japan.

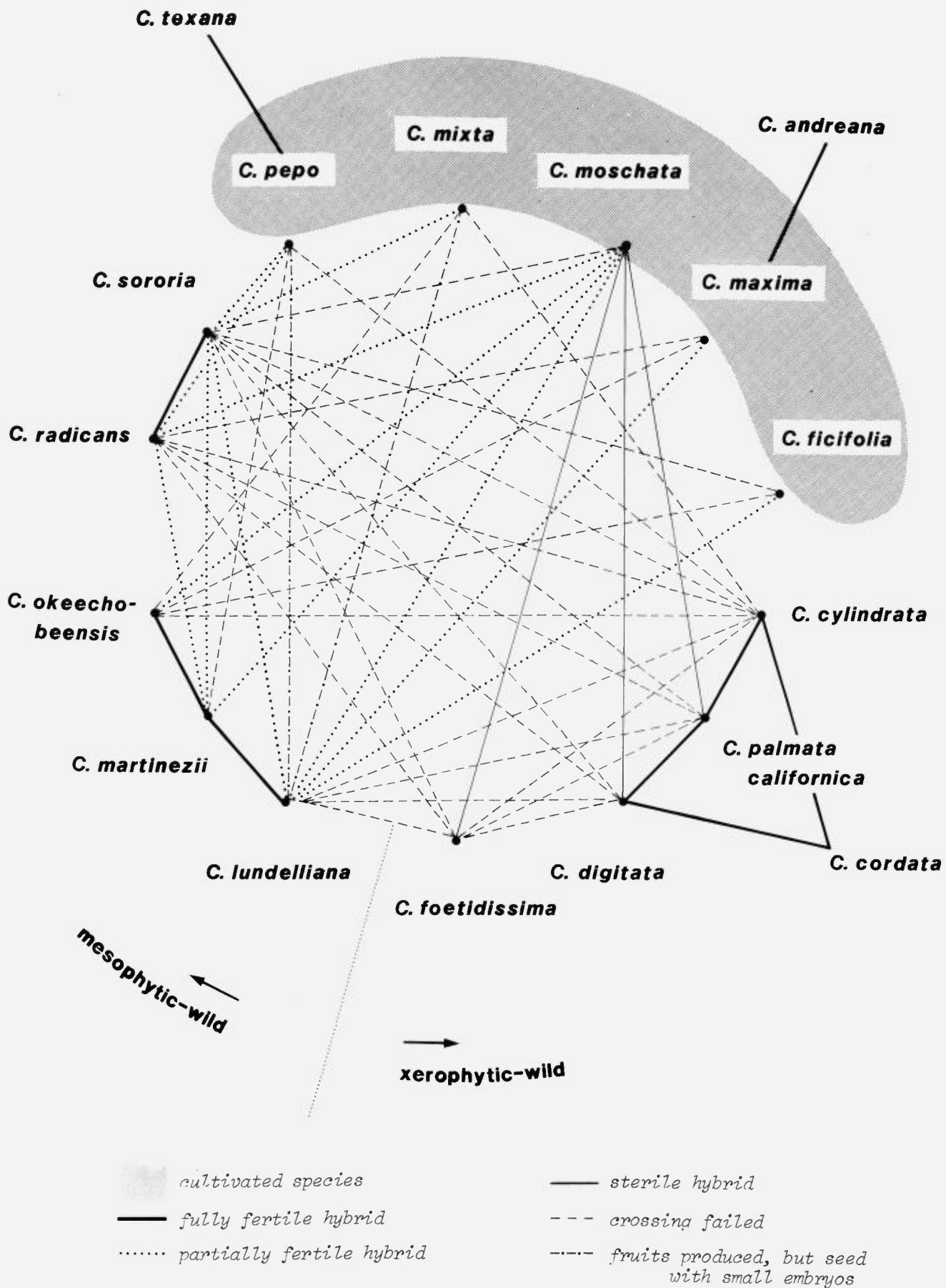
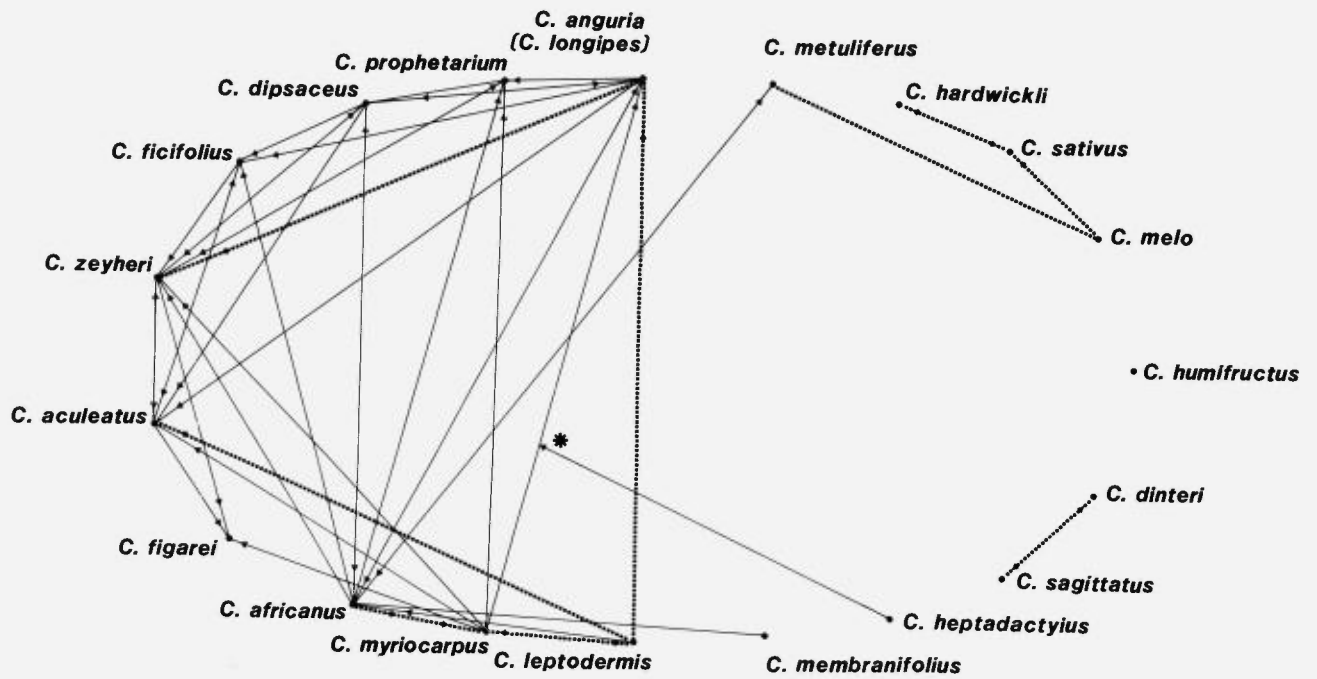


Figure 8. Interspecific crossability in wild *Cucurbita* spp.



..... crosses producing viable F_2

— crosses producing viable F_1

• arrow points towards the female parent
(some authors do not indicate the direction of the cross)

* cross: (*C. anquira* X *C. myriocarpus*) F_1 X *C. heptadactylus*

Figure 9. Interspecific crossability among Cucumis spp.

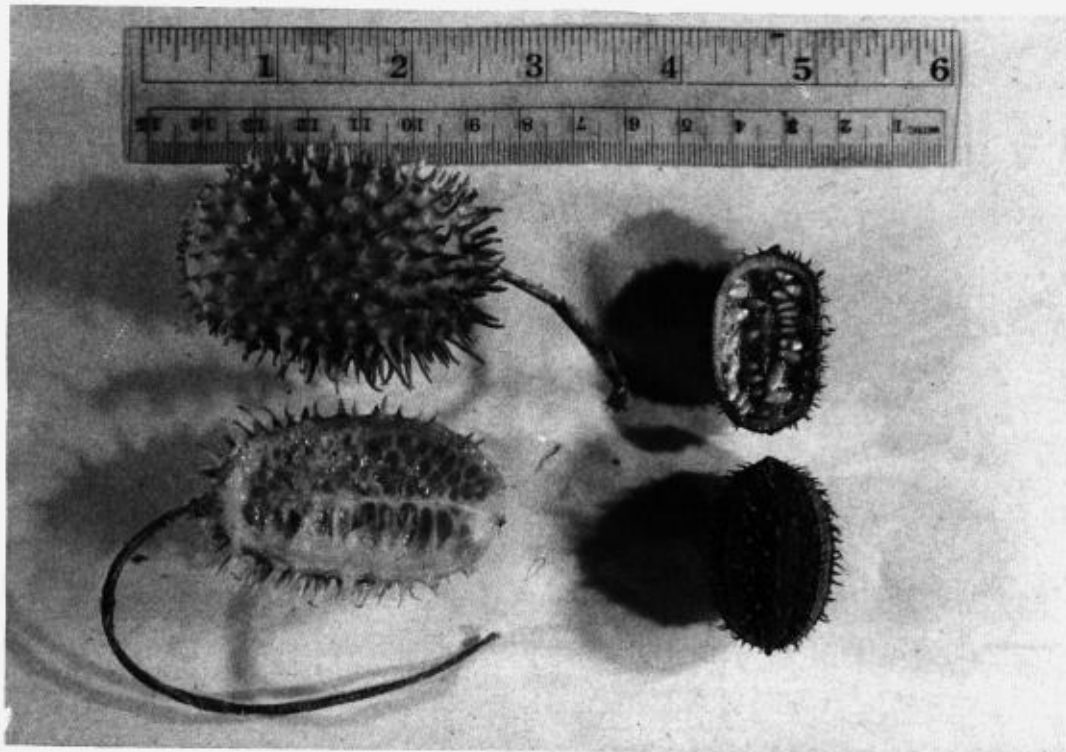


Figure 10. Wild Cucumis from Africa



Figure 11. A once popular primitive landrace of melon (Cucumis melo) from Villaconejos, Spain which today has largely disappeared as a result of genetic erosion

New reports of interspecific hybrids appear frequently in the literature and there have been many reports of varying success using special techniques such as mentor pollen, growth regulator application, stigma manipulation or embryo culture. Somatic cell hybridization techniques give new possibilities for gene transfer between related species where sexual hybrids cannot be obtained.

V. VARIABILITY AND GENETIC EROSION

Table 7 (pp. 22-23) summarizes the available information on variability and genetic erosion of species in specified geographical areas. This information has been obtained either through specific soliciting or a survey of the limited literature available.

The genetic erosion of Cucurbita maxima in the USA gives a striking example of the danger of the loss of unique germplasm. In 1935 "The Vegetables of New York" listed about 200 cultivars of C. maxima. Today there are no more than 20 cultivars available in markets, although there may be still about 100 of the old cultivars available in breeders' collections.

VI. EXISTING GERmplasm COLLECTIONS

Table 8 (pp.24-27) provides basic information on the holdings in the existing collections worldwide. Table 9 (pp. 28-29) provides complementary information on the storage conditions, availability of samples, duplication and documentation for the major world collections. More detailed information on collections is provided in the "Directory of Germplasm Collections, 4. Vegetables", by J. Toll and D.H. van Sloten, IBPGR, Rome, 1982.

Table 7. Diversity and Genetic Erosion

| Name | Culti- vated/ Wild* | Countries/regions showing variability | Genetic variability** | Genetic erosion** |
|---------------------------|---------------------------|--|--------------------------|----------------------|
| <u>Citrullus lanatus</u> | C | India | H | H |
| | C | Southern USSR, Iran | L | M |
| | C | Tropical Africa | L | M |
| | C | South and Southwest Africa (Kalahari re- gion) | H | L |
| | W | South and Southwest Africa (Kalahari re- gion) | VH | - |
| <u>Cucumis anguria</u> | C | Brazil | H | L |
| | W | Tropical and southern Africa | H | - |
| <u>Cucumis melo</u> | C | India, Southeast Asia, southern China | VH | M |
| | C | Southwest Asia (Turkey-Afghanistan) | VH | H |
| | C | Tropical Africa, esp. Sudan | M | - |
| | C | Iberian peninsula | H | VH |
| | W | South and tropical Africa | M | - |
| | W | India | H | L |
| <u>Cucumis sativus</u> | C | India, Burma, southern China | VH | H |
| | W | India, Burma, southern China | H | H |
| <u>Cucurbita pepo</u> | C | Northern Mexico | VH | M |
| <u>Cucurbita maxima</u> | C | Bolivia, northern Argentina, northern Chile | VH | L |
| | C | Southern Brazil | M | L |
| | C | Northeastern Brazil | H | L |
| | C | Peru (coastal valleys), Inter-Andean valleys | VH | VH |
| <u>Cucurbita mixta</u> | C | Central and southern Mexico | H | M |
| | C | Central America | | |
| <u>Cucurbita moschata</u> | C | Mexico | H | M |
| | C | Nicaragua (interior) | M | M |
| | C | Costa Rica | H | M |
| | C | Honduras | H | L |
| | C | Guatemala | VH | - |

Table 7. Diversity and Genetic Erosion (Cont.)

| Name | Culti- vated/ Wild* | Countries/regions showing variability | Genetic variability** | Genetic erosion** |
|--|---------------------------|--|--------------------------|----------------------|
| <u>Cucurbita moschata</u> (continued) | C | Panama | M | L |
| | C | Southern Brazil | VH | H |
| | C | Northeast Brazil | H | M |
| | C | Northern Colombia | H | M |
| | C | Peru (coastal valleys) Inter-Andean valleys | H M | VH M |
| <u>Cucurbita ficifolia</u> | C | Mexico to Colombia | M | L |
| | W | Brazil | H | M |
| <u>Benincasa hispida</u> | C | India, Burma, Thailand | M | - |
| | C | Indonesia, Malaysia, Papua New Guinea | VH | - |
| <u>Lagenaria siceraria</u> | C | Peru | VH | M |
| | C | Brazil | H | VH |
| | C | Other tropics | H | L |
| <u>Luffa cylindrica</u> | C | India, Southeast Asia | L | - |
| | W | India | H | - |
| | W | Arabian Peninsula | H | - |
| <u>Luffa acutangula</u> | C | India, Arabian Peninsula | M | - |
| <u>Momordica charantia</u> | C | Indochina | M | L |
| | C | China | M | L |
| | C | Southeast Asia | H | H |
| | C | India | M | L |
| | W | Africa | H | L |
| <u>Sechium edule</u> | C | Mexico | H | M |
| | C | Central America | VH | H |
| | C | Brazil | VH | M |
| | W | Brazil | L | - |
| | W | Costa Rica | VH | - |
| | W | Mexico | H | M |
| | W | Central America | H | - |
| <u>Sicara odorifera</u> | C | Colombia, Central America | - | - |
| <u>Trichosanthes cucumerina</u> | C and W | South and Southeast Asia | M | - |

* "Wild" also includes related species

** VH = Very high; H = High; M = Medium; L = Low

Table 8. Germplasm Collections of Cucurbitaceae Species

| Organizations | Species | <u>Bentincasa hispida</u> | <u>Citrullus lanatus</u> | <u>Citrullus</u> spp. | <u>Cucumis melo</u> | <u>Cucumis sativus</u> | <u>Cucumis</u> spp. | <u>Cucurbita andreana</u> | <u>Cucurbita ficifolia</u> | <u>Cucurbita foetidissima</u> | <u>Cucurbita maxima</u> | <u>Cucurbita mixta</u> | <u>Cucurbita moschata</u> | <u>Cucurbita pepo</u> | <u>Cucurbita</u> spp. | <u>Cyclanthera pedata</u> | <u>Lagenaria siceraria</u> | <u>Luffa</u> spp. | <u>Momordica</u> spp. | <u>Sechium edule</u> | <u>Trichosanthes</u> spp. | COMMENT/ | |
|---------------------------------------|---------|---------------------------|--------------------------|-----------------------|---------------------|------------------------|---------------------|---------------------------|----------------------------|-------------------------------|-------------------------|------------------------|---------------------------|-----------------------|-----------------------|---------------------------|----------------------------|-------------------|-----------------------|----------------------|---------------------------|----------|---------------|
| <u>Argentina</u> INTA, Pergamino | | | | | | | | 3/ | | | 3/ | 3/ | | | | | | | | | | B & A | |
| INTA, San Pedro | | | | | | | | 20 | | | 10 | | 20 | | | | | | | | | | A |
| <u>Brazil</u> UFV, Viçosa | | | | | | | | | | | 4/ | | 4/ | | | | | | | | 50 | | A (living) |
| CNPq, EMBRAPA, Brasília | | | | | | | | | 1 | | 20 | | 7 | 22 | 65 | | | | | | | | B & A |
| <u>Bulgaria</u> IPIGR, Sadovo | | 172 | | | 156 | | | | | | | | | | | | | | | | | | A |
| MIVC, Plovdiv | | | | | | 71 | | | | | | | | | | | | | | | | | A |
| <u>China</u> Shandong | | | | | | 214 | | | | | | | | | | | | | | | | | A |
| <u>Colombia</u> ICA, Palmira | | | | | | | | | | | | 3 | 14 | | | | | | | | | | A |
| <u>Costa Rica</u> CATIE, Turrialba | | | | | 2 | | | | | | 38 | 37 | 330 | 51 | 815 | | | | | | 1105/ | | B & A |
| <u>Czechoslovakia</u> RIPP, Prague | | 3 | | | 2 | 89 | | | | | 2 | | | 3 | | | | | | | | | A |
| <u>Ethiopia</u> PGRC, Addis Ababa | | | | | | | | | | | | | | 295/ | | | | | | | | | B & A |

1/ A=Active collections B=Base collections 3/ 82 C. andreana, C. maxima and C. mixta 5/ Plants
 2/ U=Unknown number 4/ 400 C. maxima and C. moschata

Table 8. Germplasm Collections of Cucurbitaceae Species (Cont.)

| Organizations | Species | <i>Bentincasa hispida</i> | <i>Citrullus lanatus</i> | <i>Citrullus</i> spp. | <i>Cucumis melo</i> | <i>Cucumis sativus</i> | <i>Cucumis</i> spp. | <i>Cucurbita andreana</i> | <i>Cucurbita ficifolia</i> | <i>Cucurbita foetidissima</i> | <i>Cucurbita maxima</i> | <i>Cucurbita mixta</i> | <i>Cucurbita moschata</i> | <i>Cucurbita pepo</i> | <i>Cucurbita</i> spp. | <i>Cyclanthera pedata</i> | <i>Lagenaria siceraria</i> | <i>Luffa</i> spp. | <i>Momordica</i> spp. | <i>Sechium edule</i> | <i>Trichosanthes</i> spp. | COMMENT ^{1/} | |
|--|---------|---------------------------|--------------------------|-----------------------|---------------------|------------------------|---------------------|---------------------------|----------------------------|-------------------------------|-------------------------|------------------------|---------------------------|-----------------------|-----------------------|---------------------------|----------------------------|-------------------|-----------------------|----------------------|---------------------------|-----------------------|-------|
| France INRA, Mont-favet-Avignon | | | | | 240 | | | | | | | | | | | | | | | | | | |
| German Dem. Rep. ZIGuK, Gatersleben | | u ^{2/} | 8 | | 133 | 193 | u ^{2/} 3/ | | | | 41 | | | 81 | u ^{2/} 4/ | u ^{2/} | 4 | u ^{2/} | u ^{2/} | | u ^{2/} | | B & A |
| Hungary NIAVT, Tapioszele VCRI, Budapest | | | 44 | | 98 | 60 | | | | | 78 | | 2 | 46 | | | 2 | | | | | | B & A |
| India IIHR ^{5/} NBPCR, New Delhi NBPCR, Phalgi NBPCR, Vellenikhara KAU, Vellenikhara VPAS, Uttar Pradesh | | | 500 | | 430 | 20 | 32 | | | 300 | | | | | 136 | | 55 | 16 | 65 | | 13 | | A |
| | | | | | | | | | | | | | | | 80 | | 28 | 4 | 4 | | 3 | | A |
| | | | | | | | | | | | | | | | | | | | 55 | | 17 | | A |
| | | | | | 166/ | 10 | | | | 1 | | | | 3 | | | 30 | 21 | 95 | | 27 | | A |
| Iraq ARC, Abu Ghraib | | | 5 | | | | 17 | | | | | | | | 5 | | 30 | 9 | 23 | | | | B & A |
| Italy IG, Bari | | | 11 | | | | 69 | | | | | | | | | | | | | | | | B & A |
| Japan NIAS, Ibaraki PGL, Kyoto | | | 33 | | 122 | 121 | 11 | | | 17 | | | 37 | 3 | 13 | | 45 | 21 | 2 | | | | B & A |

1/ A=Active collections B=Base collections 3/ Includes 10 wild species 5/ Also has 181 accessions of unspecified Cucurbitaceae
 2/ U=Unknown number 4/ Includes 8 wild species 6/ Includes 13 wild species

Table 8. Germplasm Collections of Cucurbitaceae Species (Cont.)

| Organizations | Species | | | | | | | | | | | | | COMMENT ^{1/} | | | | | | | |
|--------------------------------|--------------------------|--------------------------|-----------------------|---------------------|------------------------|---------------------|---------------------------|----------------------------|-------------------------------|-------------------------|------------------------|---------------------------|-----------------------|-----------------------|-----------------------|---------------------------|----------------------------|-------------------|-----------------------|----------------------|---------------------------|
| | <i>Benincasa hispida</i> | <i>Citrullus lanatus</i> | <i>Citrullus</i> spp. | <i>Cucumis melo</i> | <i>Cucumis sativus</i> | <i>Cucumis</i> spp. | <i>Cucurbita andreana</i> | <i>Cucurbita ficifolia</i> | <i>Cucurbita foetidissima</i> | <i>Cucurbita maxima</i> | <i>Cucurbita mixta</i> | <i>Cucurbita moschata</i> | <i>Cucurbita pepo</i> | | <i>Cucurbita</i> spp. | <i>Cyclanthera pedata</i> | <i>Lagenaria siceraria</i> | <i>Luffa</i> spp. | <i>Momordica</i> spp. | <i>Sechium edule</i> | <i>Trichosanthes</i> spp. |
| Mexico INIA, Celaya | | | | | | | | 12 | 11 | 24 | 136 | 77 | 107 | 100 | | | | 15 | | | A |
| Netherlands IVT, Wageningen | | | | 3253/ | 19303/ | 1364/ | | | | | | | | 35 | | | u ^{2/} / | u ^{2/} / | | | A |
| Nigeria NIHORT, Ibadan | | 48 | 10 | 11 | 9 | 17 | | | 7 | | | | 15 | | | | | | | | B & A |
| Pakistan ARC, Islamabad | | 5/ | 5/ | 5/ | 5/ | 5/ | | | | | | | | | | | | | | | B & A |
| Peru UNA, Lima | | 15 | | 22 | 19 | | | | | | | | | 78 | 17 | | | | | | A |
| Philippines IPG, Laguna | | 55 | | 117 | 461 | 252 | | | 98 | | | | | | | | | 72 | | | B & A |
| Poland IHAR, Warsaw | | | | u ^{2/} / | 11 | | | | 2 | | | | | | | | | | | | B & A |
| South Africa DPSC, Pretoria | | 42 | 4 | 31 | 2 | 466/ | | 2 | 13 | | | 8 | 14 | 21 | | | | 7 | | | B & A |
| Spain INIA, Madrid | | | | 5683/ | 11 | 76 | | | | | | | | | | | | | | | A |
| Thailand KU, Bangkok | | | | | | | | | | | | | | | | | | 250 | | | A |

1/ A=Active collections B=Base collections

3/ Some accessions are wild species

5/ A total of 63 of these species

6/ Wild species

4/ Includes 13 wild species

Table 8. Germplasm Collections of Cucurbitaceae Species (Cont.)

| Organizations | Species | | | | | | | | | | COMMENT ^{1/} | | | | | | | | | | |
|---|-------------------|-------------------|----------------|--------------|-----------------|--------------|--------------------|---------------------|------------------------|------------------|-----------------------|-----------------|--------------------|----------------|----------------|--------------------|---------------------|------------|----------------|---------------|--------------------|
| | Benincasa hispida | Citrullus lanatus | Citrullus spp. | Cucumis melo | Cucumis sativus | Cucumis spp. | Cucurbita andreana | Cucurbita ficifolia | Cucurbita foetidissima | Cucurbita maxima | | Cucurbita mixta | Cucurbita moschata | Cucurbita pepo | Cucurbita spp. | Cyclanthera pedata | Lagenaria siceraria | Luffa spp. | Momordica spp. | Sechium edule | Trichosanthes spp. |
| Turkey ARARI, Izmir | | 50 | | 92 | 33 | 21 | | | 4 | | | 12 | 49 | 50 | | 1 | | | | | B & A |
| USSR VIR, Leningrad | | 2292 | 1 | 3776 | 2767 | | 3/ | 3/ | 3/ | | | 3/ | 3/ | 539 | | | | | | | B & A |
| USA NSSL, Colorado | | 696 | | 1024 | 235 | 264/ | 1 | 4 | 337 | 5 | 141 | 162 | 35/ | 35/ | | 32 | 48 | 1 | | 1 | B & A |
| NCRPIS, Iowa | | | | | 662 | 136/ | | | 59 | 1 | 8 | 431 | 15/ | 15/ | | | | | | | A |
| SRPIS, Georgia | 15 | 983 | | 2099 | | | 25 | | | 64 | 268 | 2 | 383/ | 383/ | | 87 | 24 | 12 | | | A |
| NRPIS, New York | | | 767/ | 3537/ | 260 | 247/ | 3 | | 412 | | 62 | 1 | 187/ | 187/ | | | | | | | A |
| UA, Arizona | | | | | | | | 145 | | | | | | | | | | | | | A |
| IVCRC, California | 3 | U2/ | | U2/ | U2/ | U2/7/ | 18 | 13 | 18 | 47 | 59 | 60 | 2308/ | 2308/ | | | | | | | A |
| Robinson's ^{10/} Geneva, N.Y. | 2 | 109/ | 107/ | 159/ | 1109/ | 1117/ | 15 | 14 | 109/ | 25 | 59/ | 159/ | 557/ | 557/ | 10 | 20 | 123/ | 133/ | | 153/ | A |

1/ A=Active collections B=Base collections 3/ A total of 2101 C. ficifolia, C. maxima, 7/ Some accessions are wild species
 2/ U=Unknown number C. moschata and C. pepo 8/ 16 different species
 4/ Includes 11 wild species 9/ Mutants
 5/ Wild species 10/ Also has 118 additional accessions
 6/ Includes 8 wild species of Cucurbitaceae species

Table 9. Current Situation of Major World Collections

| Collection | Storage | Free availability | Duplicates | Evaluation | Documentation |
|-----------------------------------|---|--|---|--|--------------------------------------|
| Viçosa, Brazil | 5-30°C | Yes | - | - | Partial & manual |
| IPIGR, Bulgaria | -18°C 25-30% RH | Yes, for accessions listed in <u>Index Seminum</u> | - | Morphological, biological agronomical & chemical | Computerization |
| CATIE, Costa Rica | -20°C +5°C 30-35% RH | Yes | - | Characterization & preliminary | Computerization planned |
| INRA, France | 3°C 30% RH | Yes | - | Resistant to <u>Fusarium</u> | Partial & manual |
| ZIGuK, German Democratic Republic | -10°C 0°C 30% RH | Yes, for accessions listed in <u>Index Seminum</u> | - | - | Manual; computerization in progress |
| NIAS, Japan | -10°C -1°C 30% RH | Yes, for accessions listed in <u>Index Seminum</u> | - | - | Computerization in progress |
| INIA, Mexico | Cold storage planned | Yes | INIA regional station | In progress | Partial; computerization in progress |
| IVT, Netherlands | 15-20°C 30% RH | Yes, but in limited amounts | Partially, at other national institutes | Morphological and disease resistant | Manual |
| IPB, Philippines | -15°C 0°C | Yes | - | In progress | Partial & manual |
| DPSC, Pretoria, South Africa | -20°C 6-7°C 45% RH | Yes, for accessions listed in <u>Index Seminum</u> | - | Complete | Manual & computerized |
| INIA, Spain | Stored at room conditions; being transferred to -18°C; -2°C | Yes, if enough seeds | Landraces not duplicated; wild material in USDA | Morphological, agronomical & biochemical | Manual; computerization in progress |

Table 9. Current Situation of Major World Collections (Cont.)

| Collection | Storage | Free availability | Duplicates | Evaluation | Documentation |
|------------------|------------------------|--|------------|-------------------------|-------------------------------------|
| ARARI, Turkey | -15°C 0°C | Yes | - | In progress | Manual; computerization in progress |
| IVCRD, USA | 10°C 40% RH | Yes | - | Only for <u>Cucumis</u> | Partial & manual |
| NSSL, USA | -14°C | Only if unavailable from other sources | Yes* | Almost complete | Computerized |
| VIR, USSR | -10°C 4-5°C, 30% RH | Yes; some restrictions | - | - | - |

* In active collections at Regional Plant Introduction Stations



Figure 12. Collecting Seeds of Cucurbita

VII. COLLECTING

Priorities for Collecting

Priorities have been established based on the available data on distribution variability and genetic erosion and a survey of the existing collections. The level of information is dependent upon the familiarity of experts with the regions.

1. Priorities for Collecting Cucurbita

First priority

- A. Mexico: Yucatán, Chiapas, Tabasco, Huastecas, Oaxaca, Veracruz, northern and northeastern Baja California, the central plateau, the northeast coast, the central-west coast southern Michoacan and northern Guerrero (Balsas basin).
Species: Cucurbita ficifolia, C. pepo, C. mixta, C. moschata and wild Cucurbita spp.
Collecting time: September-October

B. South America

- i) Coastal valleys of Peru
Species: C. maxima, C. moschata
Collecting time: July-December
- ii) Eastern Colombia
Species: C. moschata
- iii) Northeast Brazil
Species: C. moschata
- iv) Pampa Humeda in western Argentina and in southern Uruguay
Species: C. maxima, C. pepo, C. moschata and wild C. andreana
- v) Northwestern Argentina and Bolivia
Species: C. maxima
- vi) Northeastern Argentina, Paraguay and southern Brazil
Collecting time: February-March

Second priority

- A. Guatemala and Honduras
Species: C. moschata, C. ficifolia in higher elevations, and wild species
Collecting time: September-October

- B. West foothills of the Andes, the coastal areas of Ecuador and Colombia, and inter-Andean valleys of Peru
Species: C. moschata and C. ficifolia in higher elevations (up to 2,000 m) and wild species
Collecting time: September-October

- C. Chaco area of Paraguay and Bolivia
Species: C. adreana
Collecting time: February-March

2. Priorities for Collecting Cucumis

First Priority

- A. Southwestern Asia (from Turkey to Afghanistan)
Species: C. melo
- B. India: sub-Himalayan tract to northeastern hills, western Ghats, eastern peninsular tract, and Indo-Gangetic plains
Species: Cucumis spp. wild and cultivated
- C. Burma and southern China
Species: C. melo

Second Priority

- A. India, Southeast Asia, southern China
Species: C. melo, wild C. sativus
- B. Tropical Africa, especially Sudan
Species: C. melo
- C. Tropical and southern Africa
Species: wild C. anguria (C. longipes)
- D. Iberian peninsula
Species: C. melo

3. Priorities for Collecting Citrullus

Second Priority

First Priority

- A. India: Indo-Gangetic plains, scattered areas in northwestern India
Species: C. lanatus
- B. South and southwest Africa (Kalahari region)
Species: wild and relatives of C. lanatus

Second Priority

- A. South and southwest Africa (Kalahari region)
Species: cultivated C. lanatus

Third Priority

- A. Southern USSR and Iran
Species: C. lanatus
- B. Tropical Africa
Species: C. lanatus

4. Priorities for Collecting Other Cucurbitaceae Species

First Priority

- A. Mexico
Species: Sechium edule
- B. Northeastern India, Indochina and Malaysia
Species: Momordica spp.

- A. Brazil
Species: S. edule
- B. Central America
Species: S. edule
- C. India
 - i) Northeastern hills
Species: Cucurbita spp., Benincasa spp.
 - ii) Indo-Gangetic and northwestern plains
Species: Momordica spp., Luffa spp., Lagenaria spp.
 - iii) Southern peninsular tract
Species: Trichosanthes anguina
 - iv) Bengal plains, Assam valley
 - v) Northeastern hills of North Bengal, Sikkim
Species: Cyclanthera spp., Sechium edule
- D. Arabian peninsula
Species: Luffa cylindrica
- E. South and Southeast Asia (areas not included above)
Species: Momordica spp.

Third Priority

- A. South and Southeast Asia
Species: wild and cultivated Trichosanthes cucumerina

Sampling Techniques

Because all species of Cucurbitaceae are open pollinated, much genetic variation may exist within a single cultivar; however, genetic diversity within a cultivar may be low when these crops are grown in small populations. Since genetic diversity cannot be well accessed in the field, collectors should try to preserve it by collecting seeds from a large number of plants when possible.

VIII. MAINTENANCE AND CONSERVATION

Multiplication and Regenerators

Due to the open pollinated nature of the Cucurbitaceae controlled pollination is necessary during seed increase to avoid contamination of accessions. It also requires a consideration of the use of populations large enough to preserve segregating alleles within accession samples. Potentially valuable alleles may occur at very low frequencies in accession populations, especially in wild material and landraces. The desirability of preserving these alleles must be weighed against the cost and space requirements of growing sizeable populations which can be considerable given the large size of Cucurbitaceae plants. The probability of preserving non-fixed alleles depends on the total numbers of distinct parents used in reproduction and the allelic frequency in the population. Table 10 gives the population sizes necessary to have 95% and 99% confidence of preserving alleles whose frequencies range from .90 to .01 in a cross-pollinated species, assuming random mating.

Table 10. Population sizes necessary for preserving non-fixed alleles in accession samples of cross-pollinated species (assuming random mating).

| Allele frequency in population | Population size* for confidence of | | (The figures in this table are given with the assumption that sufficient seeds will be produced by each parent to achieve .99 probability of preserving heterozygous alleles; i.e. at least 7 seeds produced by each parent. This should be mainly considered when pollen mixtures are used for crosses.) |
|--------------------------------|------------------------------------|-----|---|
| | 95% | 99% | |
| .90 | 1 | 1 | * Number of plants |
| .70 | 2 | 2 | |
| .50 | 3 | 4 | |
| .30 | 5 | 7 | |
| .10 | 15 | 22 | |
| .05 | 30 | 45 | |
| .02 | 74 | 114 | |
| .01 | 150 | 230 | |

Large populations are not necessary in cases in which it is fairly certain that an accession does not carry alleles at low frequencies. For example, an accession taken from a single isolated plant will most likely have no alleles that occur at a frequency less than 0.5 when the accession is collected.

Population sizes given in the table provide confidence that the alleles will be preserved in the succeeding generation; but the alleles will not necessarily be maintained at the same frequency. To reduce the chance of altering the allelic frequencies in the succeeding generations, an equal number of seeds should be maintained from each parent plant used in multiplication. For this purpose byparent crosses should be preferred to multiparent crosses, but when pollen mixtures are used the pollen should be thoroughly mixed. The common practice of using small numbers of plants as females and many as males saves space and work but contributes to altering the gene frequencies by giving more specific weight to alleles present in the few plants used as females.

Hand pollination requires a great deal of labour, and some institutions, especially in developed countries, use insect pollination within screened enclosures or glasshouses in order to reduce the labour involved in seed increase (Figure 13). Several sexually incompatible species are planted within a single screened enclosure. An uncontaminated beehive is placed inside and pollination is completed by the insects.

Storage

The seeds of most of the species of Cucurbitaceae maintain their viability relatively well in storage. Seeds stored in breeders' collections at 14°C and 50% RH

generally maintain their viability for 12-15 years. IBPGR has established standards and recommends that active collections be stored at 2-3°C and that seeds in long-term storage be stored at -15 to -20°C in air-tight containers after the seeds have been dried to 5-6% moisture content. This will greatly increase seed longevity; however, germinability tests must be done periodically.

Seeds of chayote (Sechium edule) are killed by drying and collections of this species must be maintained as living plants.

Proposed Centres for Base Collections

It is important that major germplasm collections are duplicated as a safety measure. Wide geographical separation and the location of these genebanks in countries with different economical, social and political structure also increases the degree of safety and availability. Based on these considerations and the interest of existing collections, the following institutions are recommended to hold the world collections of Cucurbitaceae:

1. Cucurbita spp.:

- a) Unidad de Recursos Genéticos ^{1/}
Instituto Nacional de Investigaciones Agrícolas (INIA)
Mexico 7, D.F., Mexico
- b) National Seed Storage Laboratory (NSSL)
Fort Collins, Colorado, USA
- c) N.I. Vavilov All-Union Institute of Plant Industry
Leningrad, USSR

2. Cucumis spp. and Citrullus spp.:

- a) National Bureau of Plant Genetic Resources (NBPGR) ^{1/}
New Delhi, India
- b) Instituto Nacional de Investigaciones Agrarias (INIA)
Madrid, Spain
- c) The National Horticultural Research Institute ^{1/}
Ibadan, Nigeria
- d) National Seed Storage Laboratory (NSSL)
Fort Collins, Colorado, USA
- e) N.I. Vavilov All-Union Institute of Plant Industry
Leningrad, USSR

3. Other Cucurbitaceous species:

- a) Unidad de Recursos Genéticos, Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) Turrialba, Costa Rica is recommended to hold world collections of Sechium edule, Lagenaria siceraria and wild relatives
- b) Institute for Plant Breeding (IPB), Los Banos, Philippines for holding world collections of Benincasa spp., Luffa spp., Momordica spp. and Trichosanthes spp.
- c) National Bureau of Plant Genetic Resources (NBPGR) ^{1/}, New Delhi, India for world collections of Benincasa spp., Lagenaria siceraria, Luffa spp., Momordica spp. and Trichosanthes spp.

^{1/} When long-term facilities will become available

IX. EVALUATION AND CHARACTERIZATION

Characterization and evaluation of the major collections have either not yet occurred or are underway. The systematic use of an internationally accepted minimum list of descriptors is desirable.

In properly evaluating accessions of Cucurbitaceae germplasm, the following recommendations should be taken into consideration.

- a) If the tests are conducted at one ecological station only, there should be at least replications, but it is preferable to conduct the tests at two different stations with two replications being made at each station.
- b) Tests should be carried out under conditions ensuring normal growth. The size of the plots should be such that plants, or parts of plants, may be removed for measuring and counting without undermining the observations which must be made up to the end of the growing period. The sample size should be 20 plants for each plot. It would be wise to use more plants in the cases of wild material and primitive cultivars, since resistance to certain diseases and other valuable genes in these populations may not be present in more than 1% of the genotypes (Table 10). Separate plots for observation and for measuring can only be used if they have been subject to the same environmental conditions.
- c) The minimum testing time should be two growing periods.
- d) Where resistance to pests or diseases is used for assessing distinctness, homogeneity and stability, records must be taken under conditions of controlled infection.

Descriptor lists

It is an impossible task to produce a standard list of descriptors that satisfies both breeders and curators, or even breeders alone. The three lists in Appendix IV are an attempt to reach a compromise for Cucurbita spp., Cucumis melo and Cucumis sativus respectively.



Figure 13. Glasshouses and screenhouses are often used to control pollination during multiplication of Cucurbitaceae

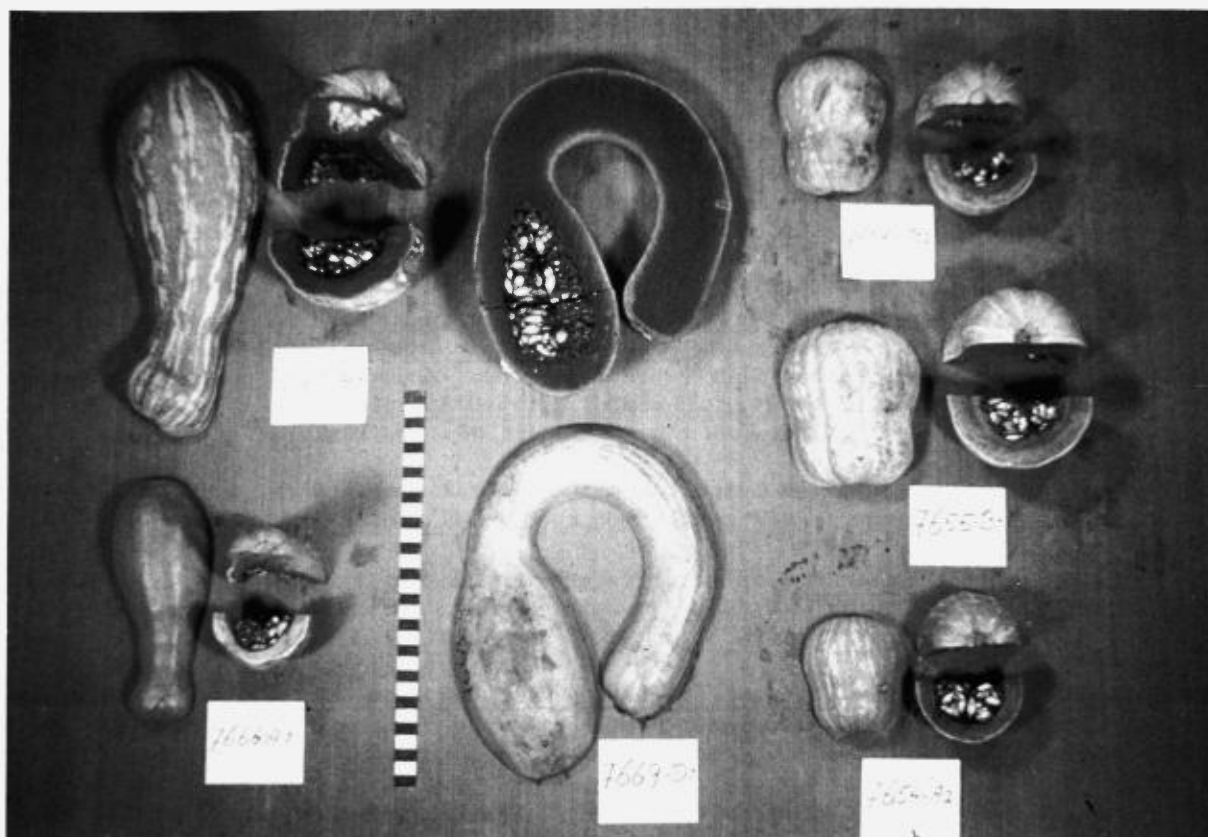


Figure 14. Fruits of Cucurbita prepared for an evaluation study



Figure 15. Root (left) and fruit, both of which are edible, of Sechium edule in a local market in Central America

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APPENDIX I

KEY CHARACTERISTICS DIFFERENTIATING THE CULTIVATED SPECIES OF CUCURBITA

| Species | Habit | Seta | Stem | Androecium | Peduncle | Fruit flesh | Funicular attachment of seed | Seed margin |
|---------------------|-----------|----------------------|---------------------------------|-------------------------|--|---|-------------------------------|------------------------|
| <u>C. pepo</u> | annual | spiculate | hard, angular | short, thick, | hard, angular, | coarse-grained | obtuse, symmetrical | smooth, obtuse |
| <u>C. moschata</u> | annual | lacking | moderately hard smoothly angled | long, slender, columnar | hard, smoothly angular, flared | fine-grained or coarse with gelatinous fibers | obtuse, slightly asymmetrical | scalloped, obtuse |
| <u>C. mixta</u> | annual | lacking | hard, angular | long, slender, columnar | hard, basically angular, but enlarged by hard cork | coarse-grained | obtuse, slightly asymmetrical | barely scalloped acute |
| <u>C. maxima</u> | annual | moderately spiculate | soft, round | short, thick, columnar | soft basically round, but enlarged by soft cork | fine-grained | acute asymmetrical | smooth obtuse |
| <u>C. ficifolia</u> | perennial | moderately spiculate | hard, smoothly angled | short thick columnar | hard smoothly angled, slightly flaring | course tough-fibrous | obtuse slightly asymmetrical | smooth, obtuse |

Reference: Whitaker and Bohn, 1950

GENES OF THE CUCURBITACEAE

The Vegetable Breeding and Varieties Committee of the American Society for Horticultural Science (ASHS) requested a group of geneticists with expertise in Cucurbitaceae, Drs. R.W. Robinson, H.M. Munger, T.W. Whitaker and G.W. Bohn, to prepare a systematic nomenclature for the known genes of the species of this family. The list of genes and gene symbols was endorsed by the ASHS and the lists were published in 1976. The following lists are primarily based on this work^{1/} with the addition of other genes which were described after the original publication. ^{2/},^{3/},^{4/}

The list provides an insight into the genetic variation that has been investigated in these species and may be found especially useful for disease-resistance genes.

Citrullus lanatus Gene Index

| Preferred symbol | Synonym | Character |
|------------------|---------|--|
| a | | andromonoecious. Recessive to <u>monoecious</u> . |
| Af | | <u>Aulacophora foveicollis</u> resistance. Resistance to the red pumpkin beetle. Dominant to susceptibility. |
| Ar | (B) Gc | <u>Anthraco</u> se resistance. Resistance to <u>Giomerella cingulata</u> var. <u>orbiculare</u> . |
| Ar-2* | | <u>Anthraco</u> se race 2 resistance. |
| C | | canary yellow flesh. Dominant to pink. |
| d | | dotted seed coat. Black dotted seed when dominant for r, t, and w. |
| db | | <u>Didymella bryoniae</u> resistance. Gummy stem blight resistance. Recessive to susceptibility. |
| dw-1 | | dwarf-1. Short internodes with fewer, shorter cells than normal. |
| dw-2 | | dwarf-2. Short internodes, due to fewer cells. |
| e | (t) | explosive rind. Thin, tender rind, bursting when cut. |
| f | | furrowed fruit surface. Recessive to smooth. |
| Fo* | | dominant gene for resistance to race 1 of <u>Fusarium oxysporum</u> |
| Fwr | | fruit fly resistance in watermelon. Dominant to susceptibility to <u>Dacus cucurbitae</u> . |
| g | (D) | light green skin. Light green fruit; recessive to dark green. |

* proposed new gene symbol.

^{1/} Robinson, R.W., Munger, H.M., Whitaker, R.W. and Bohn, G.W.
1976 Genes of Cucurbitaceae. Hort. Sci., 11(6):554-568.

^{2/} Robinson, R.W. New genes for the Cucurbitaceae.
1979 Cucurbit Genetics Cooperative, 2:49-53.

^{3/} Cucurbit Gene List Committee. Update of cucurbit gene list and nomenclature
1982 rules. Cucurbit Genetics Cooperative 5:62-65.

^{4/} Robinson, R.W. (Personal communication).
1983

Citrullus lanatus Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|---------------------|--|
| g ^S | (d ^S) | striped green skin. Recessive to dark green but dominant to light green skin. |
| go | (c) | golden. Yellow colour of older leaves and mature fruit. |
| gms | (ms _g) | glabrous male sterile. Foliage lacking trichomes; male sterile. |
| l | | long seed. Long recessive to medium length of seed; interacts with S. |
| m | | mottled skin. Greenish white mottling of fruit skin. |
| nl | | nonlobed leaves. Leaves lack lobing; dominance incomplete. |
| O | | oval fruit. Incompletely dominant to spherical. |
| p | | pencilled lines on skin. Inconspicuous stripes, recessive to netted fruit. |
| pm | | powdery mildew susceptibility. Susceptibility to <u>Sphaerotheca fuliginea</u> . |
| r | | red seed coat. Interacts with w and t. |
| s | | short seeds. Epistatic to l. |
| su | (su ^{Bi}) | suppressor of bitterness. Nonbitter fruit. |
| t | (b ^t) | tan seed coat. Interacts with r and w. |
| w | | white seed coat. Interacts with r and t. |
| Wf. | (W) | white flesh. Dominant to red. |
| y | (r) | yellow flesh. Recessive to red. |

Cucumis melo Gene Index

| | | |
|-------------|-----------------------|---|
| a | (M) | andromonoecious. Mostly staminate, fewer perfect flowers; interacts with g. |
| ab | | abrachiate. Lacking lateral branches; "ab a" plants produce only staminate flowers. |
| Af | | <u>Aulacophora foveicollis</u> resistance. Resistance to pumpkin beetle. |
| Ag | | <u>Aphis gossypii</u> tolerance. Freedom from leaf curling following aphid infestation. |
| Al-1 | <u>Al₁</u> | abscission layer-1. One of two dominant genes for abscission layer formation. |
| Al-2 | <u>Al₂</u> | abscission layer-2. One of two dominant genes for abscission layer formation. |
| b | | bush. Short internodes, compact plant habit. |
| Bi | | bitter. Bitter seedling; dominant to nonbitter. |
| dc-1 | | <u>Dacus cucurbitae</u> resistance. One of two complimentary recessive genes for resistance to the melon fruit fly. |
| <u>dc-2</u> | | <u>Dacus cucurbitae</u> resistance. One of two complimentary recessive genes for resistance to the melon fruit fly. |
| Fn | | <u>Flaccida necrosis</u> . Resistance to musk melon yellow stunt virus. |
| Fom-1 | (Fom ₁) | <u>Fusarium oxysporum</u> f. <u>melonis</u> resistance. Resistance to race 1 of <u>Fusarium</u> wilt. |

* proposed new gene symbol.

Cucumis melo Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|--------------------|---|
| Fom-2 | Fom _{1,2} | <u>Fusarium oxysporum</u> f. <u>melonis</u> resistance. Resistance to race 1 and 2 of <u>Fusarium</u> wilt. |
| g | | gynomonoecious. Mostly pistillate, fewer perfect flowers |
| gf | | green flesh colour. Recessive to salmon. |
| gi | | glabrous. Trichomes lacking. |
| gp | | green petals. Corolla leaf-like in colour and venation. |
| h | | halo cotyledons. Yellow cotyledons, later becoming green. |
| jf | | juicy flesh. Juicy flesh recessive to less juicy; segregates discretely in monogenic ration in segregating generations. |
| l | hh | lobed leaves. Deeply lobed leaves. |
| Mc | | <u>Mycosphaerella</u> <u>citrullina</u> resistance. High degree of resistance to gummy stem blight. |
| Mc-2 | (Mc ¹) | <u>Mycosphaerella</u> <u>citrullina</u> resistance. High degree of resistance to gummy stem blight. |
| ms-1 | (ms ¹) | male sterile-1. Indehiscent anthers with empty pollen walls in tetrads. |
| ms-2 | (ms ²) | male sterile-2. Anthers indehiscent, containing mostly empty pollen walls, growth rate reduced. |
| n | | nectarless. Nectaries lacking in all flowers. |
| nsv | | necrotic spot virus resistance. |
| o | | oval fruit shape. Dominant to round; associated with "a". |
| P | | pentamerous. Give carpels and stamens; recessive to trimerous. |
| Pa | | pale green foliage. |
| Pm-1 | (Pm ¹) | powdery mildew resistance. Resistance to race 1 of <u>Sphaerotheca</u> <u>fulgienea</u> . |
| Pm-2 | (Pm ²) | powdery mildew resistance-2. Race-2 resistance, incompletely dominant. |
| Pm-3 | (Pm ³) | powdery mildew resistance-3. Resistance derived from P1 124111. |
| Pm-4 | (Pm ⁴) | powdery mildew resistance-4. Resistance derived from cv. Seminole. |
| Pm-5 | (Pm ⁵) | powdery mildew resistance-5. Resistance derived from cv. Seminole. |
| r | | red stem. Red pigment under epidermis of stems, especially at nodes. |
| ri | | ridge. Ridged fruit surface recessive to ridgeless. |
| s | | sutures. Presence of vein tracts ("sutures"); recessive to ribless. |
| So | | sour taste. Dominant to sweet. |
| sp | | spherical fruit shape. Recessive to obtuse; dominance incomplete. |
| st | | striped epicarp. Recessive to nonstriped fruit. |
| v | | virescent |
| vat | | virus aphid transmission resistance. |
| w | | white colour of mature fruit. Recessive to dark green fruit skin |

* proposed new gene symbol.

Cucumis melo Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|---------|---|
| wf | | white flesh. Recessive to orange. |
| wi | | white colour of immature fruit. Dominant to green. |
| Wmv | | watermelon mosaic virus-1. |
| Wt | | white testa. Dominant to yellow or tan seed coat colour. |
| Y | | yellow epicarp. Dominant to white fruit skin. |
| yg | (y) | yellow green leaves. Reduced chlorophyll content. |
| yv | | yellow virescence. Pale cotyledons; yellow green young leaves and tendrils; bright yellow petals and yellow stigma; etiolated; older leaves becoming green. |

Cucumis metuliferus Gene Index

| | | |
|-------------------------|--|---|
| <u>Wmv</u> ^o | | watermelon mosaic virus resistance. Resistance to watermelon virus-1; dominant to susceptibility. |
|-------------------------|--|---|

Cucumis sativus Gene Index

| | | |
|-----|-----|---|
| a | | androecious. Produces primarily staminate flowers if recessive for F. |
| ap | | apetalous male sterile. |
| Ar | | <u>Anthraco</u> se resistance. One of several genes for resistance to <u>Colleotrichum lagenarium</u> . |
| B | | black or bown spines. Dominant to white spines on fruit. |
| B-2 | (C) | black spines-2. Interacts with B to produce F ₂ of 15 black: 1 white spine. |
| bi | | bitterfree. All plant parts lacking cucurbitacins. |
| bl | (t) | blind. Terminal bud lacking after temperature shock. |
| bt | | bitter fruit. Extremely bitter flavour. |
| bu | | bush; shortened internodes. |
| Bw | | bacterial wilt resistance. Resistance to <u>Erwinia tracheiphila</u> . |
| c | | cream colour of mature fruit. Interaction with R is evident in the F ₂ ratio of 9 red (R+): 3 orange (Rc): 3 yellow (++) : 1 cream (+c). |
| Cca | | <u>Corynespora cassicola</u> resistance. Resistance to target leaf spot; dominant to susceptibility. |
| Ccu | | <u>Cladosporium cucumerinum</u> resistance. Resistance to scab. |
| cd | | chlorophyll deficient. Seedling normal at first, then becoming light green; lethal unless grafted. |
| cl | | closed flower. Flowers do not open; male sterile. |
| cla | | <u>Colleotrichum lagenarium</u> resistance. Resistance to race 1 of anthracnose; recessive to susceptibility. |
| Cm | | <u>Corynespora melonis</u> resistance. Resistance to <u>C. melonis</u> ; dominant to susceptibility. |

* proposed new gene symbol.

Cucumis sativus Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|---------------------------|--|
| Cmv | | cucumber mosaic virus resistance. One of several genes for resistance to CMV. |
| co | | green corolla. Green petals and enlarged reproductive organs; female sterile. |
| cp | | compact. Reduced internode length, poorly developed tendrils, small flowers. |
| cr | | crinkled leaf. Leaves and seed crinkled. |
| D | (g) | dull skin of fruit. Dull skin of American cultivars, dominant to glossy skin of most European cultivars. |
| de | (l) | determinate habit. Short vine with stem terminating in flowers; modified by In-de and other genes; degree of dominance depends on gene background. |
| df | | delayed flowering. Flowering delayed by long photo-period; associated with seed dormancy. |
| dm* | (P) | downy mildew resistance. One of several genes for resistance to <u>Pseudoperonospora cubensis</u> . |
| dvl* | | divided leaf. |
| dw | | dwarf. Short internodes. |
| F | (Acr, F Acr. D, st) | female. High degree of female sex expression; interacts with a and M; strongly modified by environment and gene background. |
| Fba | | flower bud abortion. Preanthesis abortion of floral buds, ranging from 10 to 100%. |
| Foc | | <u>Fusarium oxysporum</u> f. spp. <u>cucumerinum</u> . Resistance to fusarium wilt; dominant to susceptibility. |
| g | | golden leaves. Golden colour of lower leaves. |
| gb | (n) | gooseberry fruit. Small, oval-shaped fruit. |
| gc | | golden cotyledon. Bright golden cotyledons; lethal. |
| gi | | gingko. Leaves reduced and distorted, resembling leaves of <u>Gingko</u> ; sterile |
| gl | | glabrous. Foliage lacking trichomes; fruit without spines. |
| gib | | glabrate. Stem and petioles glabrous, laminae slightly pubescent. |
| gy | (g) | gynoecious. Recessive gene for high degree of female sex expression. |
| H | | heavy netting of fruit. Dominant to no netting and completely linked or pleiotropic with black spines (B) and red mature fruit colour (R). |
| I | | intensifier of P. Modifies effect of P on fruit warts. |
| In-de | (In(de)) | intensifier of de. Reduces internode length and branching of de plants. |
| In-F | F | intensifier of female sex expression. Increases degree of female sex expression of F plants. |
| L | | locule number. Many fruit locules and pentamerous androecium; five locules recessive to the normal number of 3. |
| lh | | long hypocotyl. |
| ls | | light sensitive. Pale cotyledons, reduced growth; lethal at high light intensity. |
| m | (a, g, mo) | andromonoecious. Plants are andromonoecious if m ⁺ ; ++=monoecious, +F=gynoecious, mF=hermaphroditic. |

* proposed new gene symbol.

Cucumis sativus Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|---------|--|
| m2 | (h) | andromonoecious-2. Bisexual flowers with normal ovaries. |
| mp | | multi-pistillate; several pistillate flowers per node, recessive to single pistillate flower per node |
| ms-1 | | male sterile-1. Male flowers abort before anthesis. |
| ms-2 | | male sterile-2. Male flowers abort. |
| n | | negative geotropic penduncle response. Pistillate flowers upright; recessive to pendent position of most cultivars. |
| O | (y) | orange-yellow corolla colour. Dominant to light yellow. |
| P | | prominent tubercles. Prominent tubercles on yellow rind of <u>Cucumis sativus</u> var. <u>tuberculatus</u> , incompletely dominant to brown rind without tubercles. |
| Pc | (P) | parthenocarpy. Sets fruit without pollination. |
| pl | | pale lethal. Pale green cotyledons; lethal. |
| pm-1 | | powdery mildew resistance. Resistance to <u>Sphaerotheca fuliginea</u> . |
| pm-2 | | powdery mildew resistance. Resistance to <u>Sphaerotheca fuliginea</u> . |
| pm-3 | | powdery mildew resistance. Resistance to <u>Sphaerotheca fuliginea</u> . |
| pr | | protruding ovary. Exserted carpels. |
| R | | red mature fruit colour. Interacts with c; linked or pleiotropic with B and H. |
| rc | | revolute cotyledon. Cotyledons short, narrow, and cupped downwards; enlarged perianth. |
| ro | | rosette; short internodes, musk melon-like leaves. |
| s | (f, a) | spine size and frequency. Many small fruit spines, characteristic of European cultivars such as 'Everyday'; recessive to the few, large spines of most American cultivars. |
| sc | (cm) | stunted cotyledons. Small cotyledons; stunted plants; abnormal flowers. |
| T | | Tall plant height. Incompletely dominant to short plant height. |
| td | | tendrillless. Tendrils lacking; associated with misshapen ovaries and brittle leaves. |
| te | | tender skin of fruit. Thin, tender skin of some European cultivars; recessive to the thick, tough skin of most American cultivars. |
| Tr | | trimonoecious. Producing male, bisexual, and female flowers in this sequence during plant development. |
| Tu | | tuberculate fruit. Warty fruit, characteristic of American cultivars; dominant to the smooth, nonwarty fruits of most European cultivars. |
| u | (M) | uniform immature fruit colour. Uniform colour of European cultivars such as 'Everyday', recessive to the mottled or stippled colour of most American cultivars. |

* proposed new gene symbol.

Cucumis sativus Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|---------|---|
| v | | virescent. Yellow leaves, becoming green. |
| vvi | | variegated virescent. Yellow cotyledons, becoming green; variegated leaves. |
| w | | white immature fruit colour. Recessive to green. |
| wf | (w) | white flesh. Intense white flesh colour; recessive to dingy white; acts with yf to produce F ₂ of 12 white: (++) and + wf) 3 yellow (yf +) : 1 orange (yf wf). |
| Wmv | | watermelon mosaic virus resistance. Resistance to strain 2 of watermelon mosaic virus. |
| yc-1 | | yellow cotyledons-1. Cotyledons yellow at first, later turning green. |
| yc-2 | | yellow cotyledons-2. Virescent cotyledons. |
| yf | (v) | yellow flesh. Yellow (yf+) or orange (yf wf) flesh colour. |
| yg | (gr) | yellow green immature fruit colour. Recessive to dark green and epistatic to light green. |
| yp | | yellow plant. Light yellow green foliage. |

Cucurbita Gene Index

| | | |
|-----|------|--|
| a | | androecious. Produces only male flowers. |
| B | | bicolour fruit. Yellow fruit pigmentation developing before anthesis. |
| Bi | | bitter fruit. High cucurbitacin content in fruit. |
| bl | | blue fruit colour. Incompletely recessive to green. |
| Bu | | bush habit. Short internodes; dominant to vine habit in young plant stage but recessive at maturity. |
| C | | coloured fruit. Green fruit; epistatic to r. |
| cu | | cucurbitacin content. Reduced content of cucurbitacin B. |
| cr | | cream corolla. Cream to nearly 14 white petals for cr/cr, yellow for cr/+, and orange corolla for +/+; derived from <u>C. okeechobeensis</u> . |
| D | | dark green stem. Dominant to light green stem. |
| Di | | disc fruit shape. Dominant to spherical. |
| Est | | esterase. Electrophoretic form of alpha-naphthyl acetate esterase. |
| G* | a, m | gynoecious sex expression in <u>C. foetidissima</u> . |
| Gb* | | green band on inner side of base of petal; dominant to no band in <u>C. pepo</u> . |
| Hr | | hard rind. Dominant to soft fruit rind. |
| i | | intensifier of the cr gene for cream flowers; derived from <u>C. okeechobeensis</u> . |
| IT | | inhibitor of the T gene for trifluorolin resistance in <u>S. moschata</u> . |
| l | | light fruit colour. Uniform light intensity of fruit pigmentation. |

* proposed new gene symbol.

Cucurbita Gene Index (Cont.)

| Preferred symbol | Synonym | Character |
|------------------|--------------------|--|
| Lap | | leucine aminopeptidase. Electrophoretic form of leucine aminopeptidase. |
| lo | 1 | lobed leaves of <u>C. maxima</u> . |
| lt | | leafy tendrils. Tendrils with laminae. |
| ly | | light yellow corolla. Recessive to orange yellow. |
| M | | mottled leaves. Silver grey areas in axils of leaf veins. |
| ms-1 | (ms ₁) | male sterile-1. Male flowers abort before anthesis. |
| ms-2 | (ms ₂) | male sterile-2. Male flowers abort. |
| n | | naked seeds. Lacking a lignified seed coat. |
| Pm | | powdery mildew resistance. Resistance to <u>Sphaerotheca fuliginea</u> . |
| r | | recessive white. White fruit colour; hypostatic to C. |
| Rd* | | red skin. Red external fruit colour; dominant to green, white, yellow, and grey. |
| ro | | rosette leaf. Lower lobes of leaves slightly spiraled. |
| s | | sterile. Male flowers small, without pollen; female flower sterile. |
| St | (1 st) | striped fruit. Longitudinal stripes on fruit, conspicuous if L but inconspicuous if L+. |
| T | | trifluorololn resistance in <u>C. moschato</u> ; dominant to susceptibility to the herbicide; modified by I-T. |
| W | | white fruit. Dominant to green mature fruit. partially epistatic to Y. |
| Wf | | white flesh. Dominant to cream flesh colour. |
| Wt | | warty fruit. Dominant to smooth |
| Y | | yellow fruit colour. Dominant to green. |
| Ygp | | yellow green placenta; dominant to yellow placental colour in <u>C. pepo</u> . |
| Ys | | yellow seedling. Lacking chlorophyll; lethal. |

* proposed new gene symbol.

Gene Index of other Cucurbitacea

| Species | Preferred symbol | Character |
|----------------------------|------------------|---|
| <u>Cucumis anguria</u> | Cgm | cucumber green mottle resistance |
| <u>Lagenaria siceraria</u> | Af | <u>Aulacophora foveicollis</u> resistance. Resistance dominant to susceptibility to the red pumpkin beetle. |
| | b | bottle. Bottle-shaped fruit recessive to disk. |
| | db | dumbbell. Interacts with B to produce F ₂ of 9 club: 3 round: 4 dumbbell-shaped fruit. |

Gene Index of other Cucurbitacea (Cont.)

| Species | Preferred symbol | Character |
|-------------------------------|------------------|---|
| | G | green. Dark green fruit colour; dominant to light green. |
| | lb | light brown seed. Light brown seed coat colour recessive to brown. |
| | r | round. Round fruit; recessive to disk fruit shape. |
| <u>Luffa</u> spp. | a | andromonoecious. Staminate and perfect flowers on the same plant; interacts with g. |
| | g | gynoecious. Pistillate flowers only; interacts with <u>a</u> to produce monoecious or trimonoecious (++) , andromonoecious (a+), gynoecious (+g), or hermaphroditic (a g) plants. |
| <u>Melothria medraspatana</u> | s | small seeds. Small (3.0 mm) seed recessive to large (3.6 mm). |
| | w | white seeds. White seed coats if w/w, ashy if w/+, and black if +/+. |
| <u>Momordica charantica</u> | lbs | light brown seed. Light brown seed coat colour recessive to dark brown. |
| | ls | large seed. Large seed size; recessive to small seed size. |
| | w | white epicarp. White immature fruit skin; recessive to green. |

Acronyms used in this report

| | |
|--------|---|
| ARARI | Aegean Regional Agricultural Research Institute (Izmir, Turkey) |
| ARC | Agricultural Research Centre (Abu Ghraib, Iran) |
| ARC | Agricultural Research Council (Islamabad, Pakistan) |
| CATIE | Centro Agronomico Tropical de Investigacion y Ensenanza |
| CNPH | Centro Nacional de Pesquisa de Hortalias (Brasilia, Brazil) |
| DPSC | Division of Plant and Seed Control (Pretoria, South Africa) |
| ICA | Instituto Colombiano Agropecuario (Palmira, Colombia) |
| IG | Istituto del Germoplasma (Bari, Italy) |
| IHAR | Plant Breeding and Acclimatization Institute (Warsaw, Poland) |
| IIHR | Indian Institute of Horticultural Research (Bangalore, India) |
| INIA | Instituto Nacional de Investigaciones Agricolas (Celaya, Mexico) |
| INIA | Instituto Nacional de Investigaciones Agrarias (Madrid, Spain) |
| INRA | Institut national de la recherche agronomique (Montfaret-Avignon, France) |
| INTA | Instituto Nacional de Tecnologia Agropecuaria (Argentina) |
| IPB | Institute of Plant Breeding (Laguna, Philippines) |
| IPBR | Institute of Plant Introduction and Genetic Resources (Sadovo, Bulgaria) |
| IVCRC | Imperial Valley Conservation Research Centre (California, USA) |
| IVT | Institute for Horticultural Plant Breeding (Wageningen, Netherlands) |
| KAU | Kerala Agricultural University (Vellenkhar, India) |
| KU | Kasetsart University (Bangkok, Thailand) |
| MIVC | Maritsa Institute for Vegetable Crops (Plovdiv, Bulgaria) |
| NBPGR | National Board for Plant Genetic Resources (India) |
| NCRPIS | North Central Regional Plant Introduction Station (Iowa, USA) |
| NIAS | National Institute of Agricultural Sciences (Ibaraki, Japan) |
| NIAVT | National Institute for Agricultural Variety Testing (Tapioszele, Hungary) |
| NIHORT | National Horticultural Research Institute (Ibadan, Nigeria) |
| NRPIS | Northeast Regional Plant Introduction Station (New York, USA) |
| NSSL | National Seed Storage Laboratory (Fort Collins, USA) |
| PGI | Plant Germplasm Institute (Kyoto, Japan) |
| PGRC/E | Plant Genetic Resources Centre (Addis Ababa, Ethiopia) |
| RIPP | Research Institute of Plant Production (Prague, Czechoslovakia) |
| SRPIS | Southern Regional Plant Introduction Station (Georgia, USA) |
| UA | University of Arizona (Arizona, USA) |
| UFV | Universidade Federal de Vicosa (Vicosa, Brazil) |
| UNA | Universidad Nacional Agraria (Lima, Peru) |
| VCRI | Vegetable Crops Research Institute (Budapest, Hungary) |
| VIR | N.I. Vavilov All-Union Institute of Plant Industry (Leningrad, USSR) |
| VPAS | Vivekananda Parvatyakrishi Anusandhan Shala (Uttar Pradesh, India) |
| ZIGuK | Zentralinstitut fur Genetik und Kulturpflanzenforschung (Gatersleben, German Democratic Republic) |

DESCRIPTOR LISTS

The IBPGR now uses the following definitions in genetic resources documentation:

- i) passport data (accession identifiers and information recorded by collectors);
- ii) characterization (consists of recording those characters which are highly heritable, can be easily seen by the eye and are expressed in all environments);
- iii) preliminary evaluation (consists of recording a limited number of additional traits thought desirable by a consensus of users of the particular crop).

Characterization and preliminary evaluation will be the responsibility of the curators, while further characterization and evaluation should be carried out by the plant breeder. The data from further evaluation should be fed back to the curator who will maintain a data file.

The following internationally accepted norms for the scoring or coding of descriptor states should be followed as indicated below:

- a) measurements are made in metric units;
- b) many descriptors which are continuously variable are recorded on a 1-9 scale. The authors of this list have sometimes described only a selection of the states, e.g. 3, 5 and 7 for such descriptors. Where this has occurred the full range of codes is available for use by extension of the codes given or by interpolation between them - e.g. in 8. (Pest and disease susceptibility) 1 = extremely low susceptibility and 8 = high to extremely high susceptibility;
- c) presence/absence of characters are scored as + (present) and 0 (absent);
- d) for descriptors which are not generally uniform throughout the accession (e.g. mixed collection, genetic segregation) mean and standard deviation could be reported where the descriptor is continuous or mean and 'x' where the descriptor is discontinuous;
- e) when the descriptor is inapplicable, '0' is used as the descriptor value, e.g. if an accession does not form flowers, a 0 would be scored for the following descriptor:

Flower colour

- 1 White
- 2 Yellow
- 3 Red
- 4 Purple

- f) blanks are used, for information not yet available;
- g) standard colour charts, e.g. Royal Horticultural Society Colour Chart, Methuen Handbook of Colour, Munsell Color Charts for Plant Tissues are strongly recommended for all ungraded colour characters (the precise chart used should be specified in the NOTES descriptor, 11).

Descriptor list for Cucurbita

PASSPORT

1. ACCESSION DATA

1.1 ACCESSION NUMBER

This number serves as a unique identifier for accessions and is assigned by the curator when an accession is entered into his collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. Letters should occur before the number to identify the genebank or national system (e.g. MG indicates an accession comes from the genebank at Bari, Italy; PI indicates an accession within the USA system).

1.2 DONOR NAME

Name of institution or individual responsible for donating the germplasm.

1.3 DONOR IDENTIFICATION NUMBER

Number assigned to accession by the donor

1.4 OTHER NUMBERS ASSOCIATED WITH THE ACCESSION (other numbers can be added as 1.4.3 etc.)

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not collection number, see 2.1)

1.4.1 Other number 1

1.4.2 Other number 2

1.5 SCIENTIFIC NAME

1.5.1 Genus

1.5.2 Species

1.5.3 Subspecies

1.6 PEDIGREE/CULTIVAR NAME

Nomenclature and designations assigned to breeder's material

1.7 ACQUISITION DATE

The month and year in which the accession entered the collection, expressed numerically, e.g. June = 06, 1981 = 81

1.7.1 Month

1.7.2 Year

1.8 DATE OF LAST REGENERATION OR MULTIPLICATION

The month and year expressed numerically, e.g. October = 10, 1978 = 78

1.8.1 Month

1.8.2 Year

1.9 ACCESSION SIZE

Approximate number of seeds of accession in collection

1.10 NUMBER OF TIMES ACCESSION REGENERATED

Number of regenerations or multiplications since original collection

1.11 TYPE OF MAINTENANCE

- 1 Vegetative
- 2 Seed
- 3 Both
- 4 Tissue culture

2. COLLECTION DATA

2.1 COLLECTOR'S NUMBER

Original number assigned by collector of the sample normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections and should always accompany sub-samples wherever they are sent

2.2 COLLECTING INSTITUTE

Institute of person collecting/sponsoring the original sample

2.3 DATE OF COLLECTION OF ORIGINAL SAMPLE

Expressed numerically, e.g. March = 03, 1980 = 80

2.3.1 Month

2.3.2 Year

2.4 COUNTRY OF COLLECTION OR COUNTRY WHERE CULTIVAR/VARIETY BRED

Use the three letter abbreviations supported by the Statistical Office of the United Nations. Copies of these abbreviations are available from the IBPGR Secretariat and have been published in the FAO/IBPGR Plant Genetic Resources Newsletter number 49

2.5 PROVINCE/STATE

Name of the administrative subdivision of the country in which the sample was collected

2.6 LOCATION OF COLLECTION SITE

Number of kilometres and direction from nearest town, village or map grid reference (e.g. TIMBUKTU7S means 7 km south of Timbuktu)

2.7 LATITUDE OF COLLECTION SITE

Degrees and minutes followed by N (north) or S (south), e.g. 1030S

2.8 LONGITUDE OF COLLECTION SITE

Degrees and minutes followed by E (east) or W (west), e.g. 7625W

2.9 ALTITUDE OF COLLECTION SITE

Elevation above sea level in metres

2.10 COLLECTION SOURCE

- 1 Wild
- 2 Farm land
- 3 Farm store
- 4 Backyard
- 5 Village market
- 6 Commercial market
- 7 Institute
- 8 Other (specify in the NOTES descriptor, 11)

2.11 STATUS OF SAMPLE

- 1 Wild
- 2 Weedy
- 3 Breeders line
- 4 Primitive cultivar (landrace)
- 5 Advanced cultivar (bred)
- 6 Other (specify in the NOTES descriptor, 11)

2.12 LOCAL/VERNACULAR NAME

Name given by farmer to cultivar/landrace/weed

2.13 NUMBER OF PLANTS SAMPLED

Approximate number of plants collected in the field to produce this accession

2.14 PHOTOGRAPH

Was a photograph taken of the accession or environment at collection? If photo has been taken, provide any identification number/system in the NOTES descriptor, 11

- 0 No
+ Yes

2.15 TYPE OF SAMPLE

- 1 Vegetative
- 2 Seed
- 3 Both

2.16 HERBARIUM SPECIMEN

Was a herbarium specimen collected?

- 0 No
+ Yes

2.17 OTHER NOTES FROM COLLECTOR

Collectors will record ecological information. For cultivated crops, cultivation practices such as irrigation, season of sowing, etc. will be recorded.

CHARACTERIZATION AND PRELIMINARY EVALUATION DATA

3. SITE DATA

3.1 COUNTRY OF CHARACTERIZATION AND PRELIMINARY EVALUATION

3.2 SITE (RESEARCH INSTITUTE)

3.3 NAME OF PERSON IN CHARGE OF CHARACTERIZATION

3.4 SOWING DATE

3.4.1 Day

3.4.2 Month

3.4.3 Year

3.5 HARVEST DATE

3.5.1 Day

3.5.2 Month

3.5.3 Year

4. PLANT DATA

4.1 VEGETATIVE

4.1.1 Plant growth habit

- 3 Bushy
- 5 Intermediate
- 7 Prostrate

4.1.2 Time of maturity

- 3 Early
- 5 Intermediate
- 7 Late

4.2 INFLORESCENCE AND FRUIT

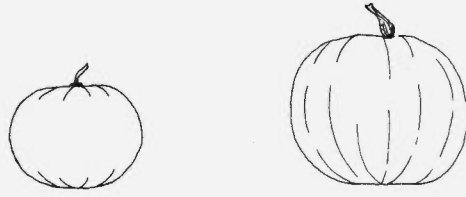
4.2.1 Peduncle transectional shape

- 3 Round
- 5 Smoothly angled
- 7 Sharply angular

4.2.2 Peduncle attachment

- 1 Hard, not flared
- 2 Hard and flared
- 3 Not flared, enlarged by hard cork
- 4 Not flared, enlarged by soft cork
- 5 Other (specify in the NOTES descriptor, 11)

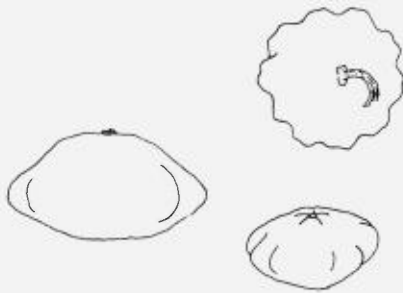
1 Globular (round)



2 Flattened

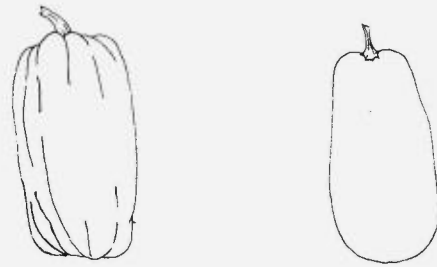


3 Disk



4 Oblong blocky

(cylindrical)



5 Elliptical (oval)

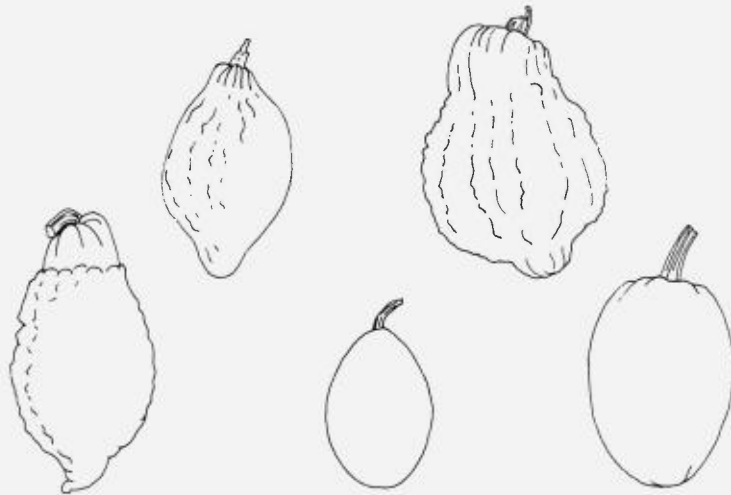
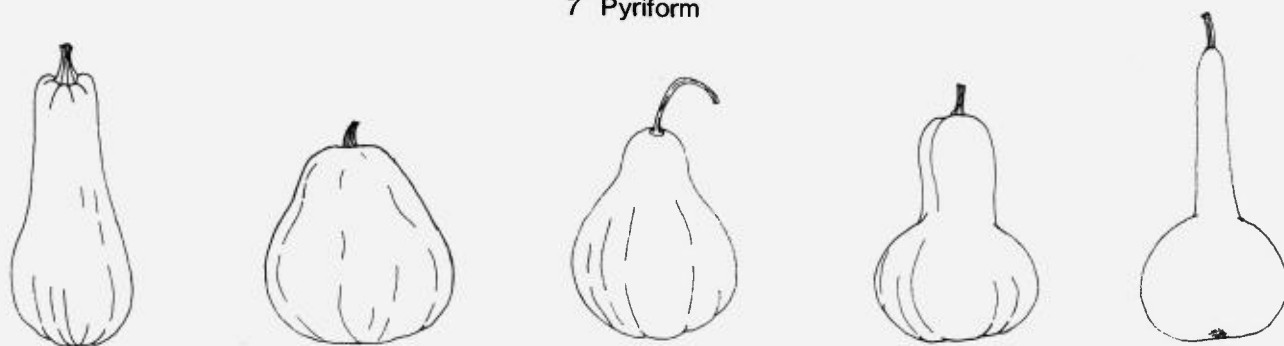


Figure 16. Cucurbita fruit shape

6 Acorn/Heart shaped



7 Pyriform



8 Dumbbell



9 Elongate forms

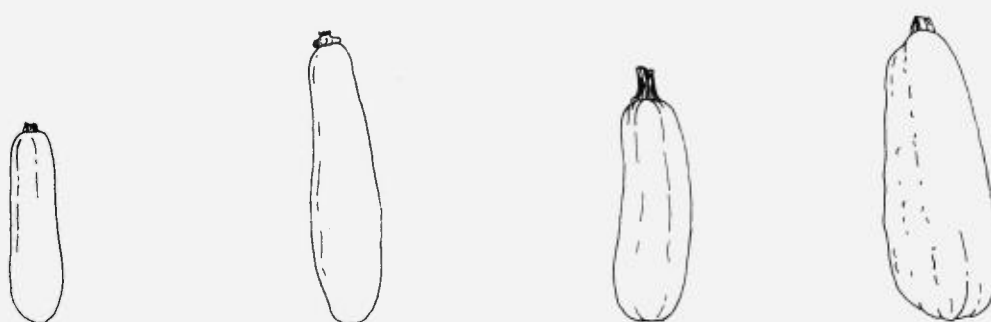


Figure 16. Cucurbita fruit shape (Cont.)

10 Turbinate superior



11 Crowned



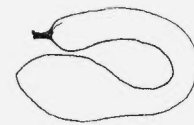
12 Turbinate inferior



13 Curved



14 Crooked neck



G D P

Figure 16. Cucurbita fruit shape (Cont.)

4.2.3 Fruit shape

See Figure 16.

- 1 Globular (round)
- 2 Flattened
- 3 Disk
- 4 Oblong blocky (cylindrical)
- 5 Elliptical (oval)
- 6 Acorn/heart shaped
- 7 Pyriform
- 8 Dumbbell
- 9 Elongate forms
- 10 Turbinate superior
- 11 Crowned
- 12 Turbinate inferior
- 13 Curved
- 14 Crooked neck
- 15 Other (specify in the NOTES descriptor, 11)

4.2.4 Fruit ribs

- 0 Absent
- 3 Superficial
- 5 Intermediate
- 7 Deep

4.2.5 Predominant fruit skin colour at maturity

Predominant colour is the colour which covers the largest surface area of the fruit. In case two colours have the same surface area the lighter colour will be considered the predominant one

- 0 No secondary skin
- 2 Green
- 3 Blue
- 4 Cream
- 5 Yellow
- 6 Orange
- 7 Red
- 8 Pink
- 9 Brown
- 10 Grey
- 11 Black
- 12 Other (specify in the NOTES descriptor, 11)

4.2.6 Secondary fruit skin colour

Secondary colour is the colour which covers the second largest area of the fruit. In case two colours have the same surface area the lighter colour will be considered the predominant one

- 0 No secondary skin
- 1 White
- 2 Green
- 3 Blue
- 4 Cream
5. Yellow
- 6 Orange
- 7 Red
- 8 Pink
- 9 Other (specify in the NOTES descriptor, 11)

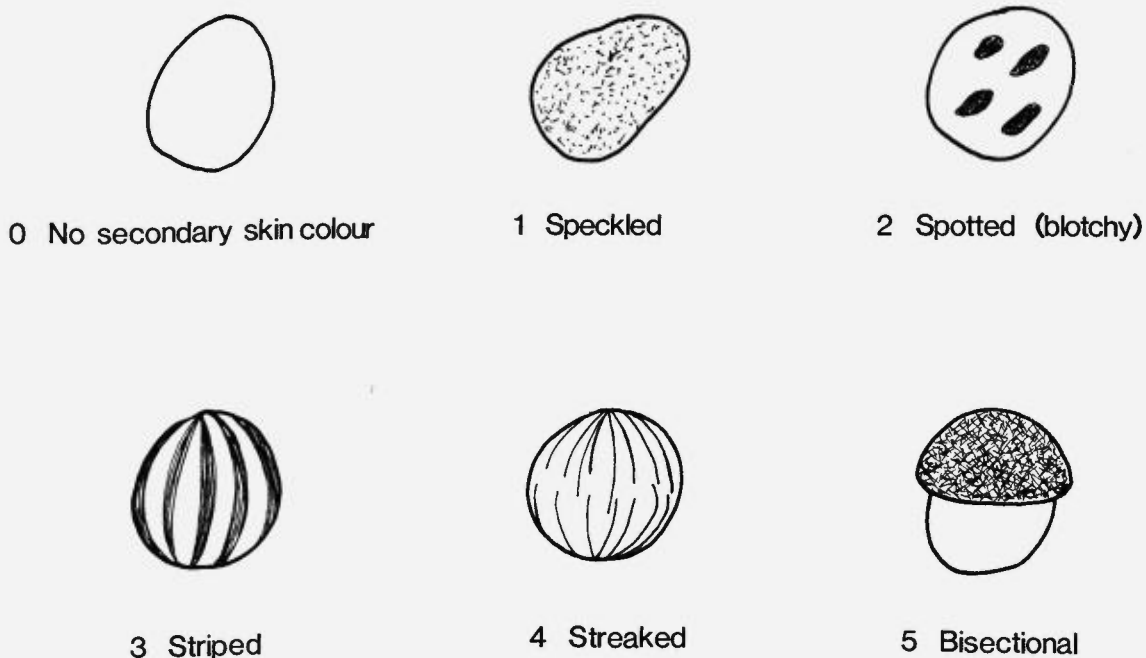


Figure 17. Design produced by secondary skin colour in Cucurbita

4.2.7 Design produced by secondary skin colour

Speckles are spots less than .5 cm; blotches are spots larger than .5 cm; stripes are bands that run from peduncle to blossom scar; short rays or streaks are elongated marks that are not continuous from one end of fruit to the other and less than 4 cm in length; long streaks are as above but longer than 4 cm. See Figure 17.

- 0 No secondary skin colour
- 1 Speckled
- 2 Spotted (blotchy)
- 3 Striped
- 4 Streaked
- 5 Bisectonal
- 6 Other (specify in the NOTES descriptor, 11)

4.2.8 Fruit skin texture

- 1 Smooth
- 2 Grainy
- 3 Finely wrinkled
- 4 Shallowly wavy
- 5 Netted
- 6 With warts
- 7 With spines
- 8 Other (specify in the NOTES descriptor, 11)

4.2.9 Fruit length

In centimetres

4.2.10 Fruit width

In centimetres

4.2.11 Fruit weight

In kilograms

4.2.12 Fruit skin hardness

- 3 Soft - easily marked by fingernail
- 5 Intermediate - difficult to mark with fingernail
- 7 Hard - impossible to mark with fingernail

4.2.13 Fruit skin thickness

To be measured in millimetres at maximum fruit diameter

4.2.14 Flesh thickness

To be measured in millimetres at maximum fruit diameter

4.2.15 Flesh colour

- 1 White
- 2 Green
- 3 Yellow
- 4 Orange
- 5 Salmon

4.3 SEED

4.3.1 Number of seeds per fruit

Give actual number as a mean of 5 randomly selected samples

4.3.2 Seed size

To be compared with that typical for crop type

- 3 Small
- 5 Intermediate
- 7 Large

4.3.3 100 seed weight

Average weight in grams of two samples of 100 randomly chosen seeds

FURTHER CHARACTERIZATION AND EVALUATION

5. SITE DATA

5.1 COUNTRY OF FURTHER CHARACTERIZATION AND EVALUATION

5.2 SITE (RESEARCH INSTITUTE)

5.3 NAME OF PERSON IN CHARGE OF EVALUATION

5.4 SOWING DATE

5.4.1 Day

5.4.2 Month

5.4.3 Year

5.5 HARVEST DATA

5.5.1 Day

5.5.2 Month

5.5.3 Year

5.6 DURATION OF VEGETATIVE PERIOD (IN DAYS)

6. PLANT DATA

6.1 VEGETATIVE

6.1.1 Cotyledon size

To be measured 2 days after emergence

3 Small (approx. 2 cm)

5 Intermediate (approx. 3 cm)

7 Large (approx. 4 cm)

6.1.2 Cotyledon colour

3 Light green

5 Intermediate

7 Dark green

6.1.3 Internode length

Measured in centimetres as a mean of 3 nodes between first and fourth inflorescence on one main stem

6.1.4 Stem shape

As observed from cross-section

1 Rounded

2 Angular

6.1.5 Tendrils

0 Absent

+ Present

6.1.6 Leaf shape

- 1 Ovate
- 2 Orbicular
- 3 Reniform
- 4 Retuse

6.1.7 Leaf size

To be compared with that typical for crop type

- 3 Small
- 5 Intermediate
- 7 Large

6.1.8 Colour of leaf spots or checks

- 0 Absent
- 1 Light green
- 2 Silver
- 3 Both
- 4 Other (specify in the NOTES descriptor, 11)

6.1.9 Leaf margin

- 1 Smooth
- 2 Dented

6.1.10 Leaf lobes

- 0 Absent
- 3 Shallow
- 5 Intermediate
- 7 Deep

6.1.11 Leaf pubescence (dorsal surface)

- 0 Absent (no hairs)
- 3 Low
- 5 Intermediate
- 7 High

6.1.12 Leaf pubescence (ventral surface)

- 0 Absent (no hairs)
- 3 Low
- 5 Intermediate
- 7 High

6.2 INFLORESCENCE AND FRUIT

6.2.1 Days to flowering

Number of days from sowing to when at least 50% of the plants have female flowers. Score '0' for androecious plants

6.2.2 Flower colour

- 1 White
- 2 Yellow
- 3 Orange
- 4 Other (specify in the NOTES descriptor, 11)

6.2.3 Flower seed

- 0 Absent
- + Present

6.2.4 Sex type

To be observed on main stem at first fruit set

Same plant

- | | |
|-------------------|---------------------------------------|
| 1 Monoecious | ♂ and ♀ |
| 2 Gynomonoecious | ♂ and ♀ |
| 3 Andromonoecious | ♂ and ♀ |
| 4 Hermaphroditic | |
| 5 Androecious | |
| 6 Gynoecious | |
| 7 Dioecious | ♂ and ♀ flowers on different plant |
| 8 Male sterile | |
| 9 Female sterile | |

6.2.5 Stem-end fruit shape

To be observed at the stem-end. See Figure 18.

- 1 Depressed
- 3 Flattened
- 5 Rounded
- 7 Pointed



Figure 18. Cucurbita stem-end fruit shape

6.2.6 Blossom-end fruit shape

To be observed at the blossom-end. See Figure 19.

- 1 Depressed
- 3 Flattened
- 5 Rounded
- 7 Pointed

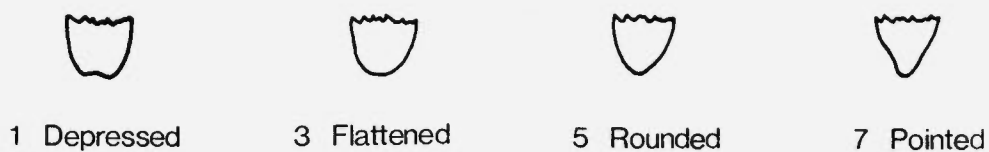


Figure 19. Blossom-end fruit shape in Cucurbita

6.2.7 Peduncle length

Measured in centimetres

6.2.8 Peduncle separation from fruit

- 3 Easy
- 5 Intermediate
- 7 Difficult

6.2.9 Fruit skin colour intensity

- 3 Light
- 5 Intermediate
- 7 Dark

6.2.10 Fruit lustre

- 3 Matt
- 5 Intermediate
- 7 Glossy

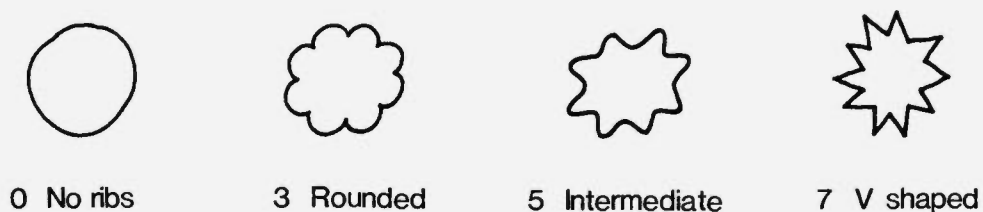


Figure 20. Fruit rib shape in Cucurbita

6.2.11 Fruit rib shape

To be observed in cross section. See Figure 20.

- 0 No ribs
- 3 Rounded
- 5 Intermediate
- 7 V shaped

6.2.12 Fruit size variability

To be compared with that typical for crop type

- 3 Low
- 5 Intermediate
- 7 High

6.2.13 Fruit volume

Specify which method used in the NOTES descriptor, 11

6.2.14 Fruit skin texture intensity

- 3 Superficial
- 5 Intermediate
- 7 Pronounced

6.2.15 Cavity diameter

To be measured in millimetres at maximum fruit diameter

6.2.16 Flesh colour intensity

- 3 Light
- 5 Intermediate
- 7 Dark

6.2.17 Flesh moisture

- 3 Low
- 5 Intermediate
- 7 High

6.2.18 Flesh texture

- 1 Smooth-firm
- 2 Grainy-firm
- 3 Soft-spongy
- 4 Fibrous-gelatinous
- 5 Fibrous-dry

6.2.19 Flesh dry matter percent

- 3 Low (10-15%)
- 5 Intermediate (20-25%)
- 7 High (30-35%)

6.2.20 Amount of placental tissue

- 3 Low
- 5 Intermediate
- 7 High

6.2.21 Ease of seed and placenta separation from flesh

- 3 Difficult
- 5 Intermediate
- 7 Easy

6.2.22 Flesh flavour

- 3 Insipid
- 5 Intermediate
- 7 Sweet

6.2.23 Fruit storage ability (ambient temperature)

- 3 Low (approx. 1 week)
- 5 Intermediate (approx. 1 month)
- 7 High (approx. 3 months)

6.3 SEED

6.3.1 Ease of seed separation from placenta

- 3 Difficult
- 5 Intermediate
- 7 Easy

6.3.2 Seed surface

- 1 Smooth
- 2 Wrinkled
- 3 Slightly pitted
- 4 Scaly
- 5 Creased

6.3.3 Seed surface lustre

- 3 Dull
- 5 Intermediate
- 7 Glossy

6.3.4 Seed coat colour

Colour of seed body excluding the margin

- 0 Seed coat absent
- 1 White
- 2 Tan
- 3 Yellow
- 4 Orange
- 5 Brown
- 6 Grey
- 7 Black

6.3.5 Seed margin

- 0 Absent
- 1 Thin and uniform
- 2 Thin and irregular
- 3 Thick and uniform
- 4 Thick and irregular

6.3.6 Seed margin colour

- 0 Seed margin absent
- 1 White
- 2 Tan
- 3 Yellow
- 4 Orange
- 5 Brown
- 6 Grey
- 7 Black

7. STRESS SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

7.1 LOW TEMPERATURE

7.2 HIGH TEMPERATURE

7.3 DROUGHT

7.4 HIGH SOIL MOISTURE

7.5 HIGH HUMIDITY

7.6 SALINITY

7.7 ACIDITY

8. DISEASE AND PEST SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

8.1 PESTS

8.1.1 Acalymma trivittata (Mann.) - Western striped cucumber beetle

8.1.2 Anasa tristis (De Geer) - Squash bug

8.1.3 Aphis gossypii (Glov.) - Melon aphid

8.1.4 Blapstinus spp. - Darkling ground beetle

8.1.5 Diabrotica balteata (Lac.) - Banded cucumber beetle

8.1.6 D. undecimpunctata (Mann.) - Western spotted cucumber beetle

8.1.7 D. undecimpunctata howardi (Barber) - Spotted cucumber beetle

8.1.8 D. virgifera - Western corn root worm

8.1.9 Empoasca abrupta (De Long) - Leaf hopper

8.1.10 E. arida (De Long) - Leaf hopper

8.1.11 E. solana (De Long) - Leaf hopper

- 8.1.12 Liriomyza spp. - Leaf miner
- 8.1.13 Melioidogyne spp. - Root-knot nematode
- 8.1.14 Melittia cucurbitae (Harris) - Squash vine borer
- 8.1.15 Myzus persicae (Sulzer) - Green peach aphid
- 8.1.16 Petrobia latens (Muller) - Brown wheat mite
- 8.1.17 Tetranychus atlanticus (McGregor) - Atlantic spider mite
- 8.1.18 T. desertorum Banks - Desert spider mite
- 8.1.19 T. pacificus (McGregor) - Pacific spider mite
- 8.1.20 T. telarius L. - Two spotted spider mite
- 8.1.21 Trialeurodes vaporariorum (Westwood) - White fly
- 8.1.22 Other (specify in the NOTES descriptor, 11)
- 8.2 FUNGI
 - 8.2.1 Alternaria cucumerina (Ell. & Ev.) J.A. Elliot
 - 8.2.2 Cercospora melonis (Cke.)
 - 8.2.3 Colletotrichum lagenarium (Pass.) - Anthracnose Race 1, Ell & Halls Race I
 - 8.2.4 C. lagenarium (Pass.) - Anthracnose Race 2, Ell & Halls Race 2
 - 8.2.5 Erysiphe cichoracearum D.C. - Powdery Mildew Race 1, (syn. Sphaerotheca fuliginea)
 - 8.2.6 Fusarium solani f. cucurbitae (Synder & Hansen) - Fusarium wilt
 - 8.2.7 Mycosphaerella citrullina (C.O. Smith) Gross - Gummy stem blight, (syn. Didymella bryoniae (Anersw.) Rehm.
 - 8.2.8 Phyllosticta cucurbitacearum (Sacc.)
 - 8.2.9 Phythium irregulare (Buis) - Seedling blight
 - 8.2.10 P. ultimum - Seedling blight
 - 8.2.11 P. aphanidermatum (Edson) Fitz
 - 8.2.12 Phytophthora capsici (Leon)
 - 8.2.13 Pseudoperonospora cubensis (Berk & Curt.) Rostow - Downy mildew
 - 8.2.14 Rhizoctonia solani (Kuhn) - Seedling blight
 - 8.2.15 Septoria cucurbitacearum (Sacc.)
 - 8.2.16 Stemphylium cucurbitacearum (Osner)
 - 8.2.17 Other (specify in the NOTES descriptor, 11)

8.3 BACTERIA

8.3.1 Erwinia tracheiphila (E.F. Sm.) Holland - Bacterial wilt

8.3.2 Other (specify in the NOTES descriptor, 11)

8.4 VIRUS

8.4.1 Cucumber mosaic virus

8.4.2 Bean yellow mosaic virus

8.4.3 Melon mosaic virus

8.4.4 Squash mosaic virus

8.4.5 Tobacco ringspot virus

8.4.6 Tomato ringspot virus

8.4.7 Watermelon mosaic virus - Race 1

8.4.8 Watermelon mosaic virus - Race 2

8.4.9 Other (specify in the NOTES descriptor, 11)

9. ALLOENZYME COMPOSITION

This may prove to be a useful tool for identifying duplicate accessions

10. CYTOLOGICAL CHARACTERS AND IDENTIFIED GENES

11. NOTES

Give additional information where descriptor state is noted as 'Other' as, for example, in descriptor 8.4.9, etc. Also include here any further relevant information

Descriptor list for Cucumis melo

PASSPORT

1. ACCESSION DATA

1.1 ACCESSION NUMBER

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1.2 DONOR NAME

Name of institution or individual responsible for donating the germplasm.

1.3 DONOR IDENTIFICATION NUMBER

Number assigned to accession by the donor

1.4 OTHER NUMBERS ASSOCIATED WITH THE ACCESSION (other numbers can be added as 1.4.3 etc.)

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not collection number, see 2.1)

1.4.1 Other number 1

1.4.2 Other number 2

1.5 SCIENTIFIC NAME

1.5.1 Genus

1.5.2 Species

1.5.3 Subspecies

1.6 PEDIGREE/CULTIVAR NAME

Nomenclature and designations assigned to breeder's material

1.7 ACQUISITION DATE

The month and year in which the accession entered the collection, expressed numerically, e.g. June = 06, 1981 = 81

1.7.1 Month

1.7.2 Year

1.8 DATE OF LAST REGENERATION OR MULTIPLICATION

The month and year expressed numerically, e.g. October = 10, 1978 = 78

1.8.1 Month

1.8.2 Year

1.9 ACCESSION SIZE

Approximate number of seeds of accession in collection

1.10 NUMBER OF TIMES ACCESSION REGENERATED

Number of regenerations or multiplications since original collection

1.11 TYPE OF MAINTENANCE

- 1 Vegetative
- 2 Seed
- 3 Both
- 4 Tissue culture

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Original number assigned by collector of the sample normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections and should always accompany sub-samples wherever they are sent

2.2 COLLECTING INSTITUTE

Institute of person collecting/sponsoring the original sample

2.3 DATE OF COLLECTION OF ORIGINAL SAMPLE

Expressed numerically, e.g. March = 03, 1980 = 80

2.3.1 Month

2.3.2 Year

2.4 COUNTRY OF COLLECTION OR COUNTRY WHERE CULTIVAR/VARIETY BRED

Use the three letter abbreviations supported by the Statistical Office of the United Nations. Copies of these abbreviations are available from the IBPGR Secretariat and have been published in the FAO/IBPGR Plant Genetic Resources Newsletter number 49

2.5 PROVINCE/STATE

Name of the administrative subdivision of the country in which the sample was collected

2.6 LOCATION OF COLLECTION SITE

Number of kilometres and direction from nearest town, village or map grid reference (e.g. TIMBUKTU7S means 7 km south of Timbuktu)

2.7 LATITUDE OF COLLECTION SITE

Degrees and minutes followed by N (north) or S (south), e.g. 1030S

2.8 LONGITUDE OF COLLECTION SITE

Degrees and minutes followed by E (east) or W (west), e.g. 7625W

2.9 ALTITUDE OF COLLECTION SITE

Elevation above sea level in metres

2.10 COLLECTION SOURCE

- 1 Wild
- 2 Farm land
- 3 Farm store
- 4 Backyard
- 5 Village market
- 6 Commercial market
- 7 Institute
- 8 Other (specify in the NOTES descriptor, 11)

2.11 STATUS OF SAMPLE

- 1 Wild
- 2 Weedy
- 3 Breeders line
- 4 Primitive cultivar (landrace)
- 5 Advanced cultivar (bred)
- 6 Other (specify in the NOTES descriptor, 11)

2.12 LOCAL/VERNACULAR NAME

Name given by farmer to cultivar/landrace/weed

2.13 NUMBER OF PLANTS SAMPLED

Approximate number of plants collected in the field to produce this accession

2.14 PHOTOGRAPH

Was a photograph taken of the accession or environment at collection? If photo has been taken, provide any identification number/system in the NOTES descriptor, 11

- 0 No
- + Yes

2.15 TYPE OF SAMPLE

- 1 Vegetative
- 2 Seed
- 3 Both

2.16 HERBARIUM SPECIMEN

Was a herbarium specimen collected?

- 0 No
- + Yes

2.17 OTHER NOTES FROM COLLECTOR

Collectors will record ecological information. For cultivated crops, cultivation practices such as irrigation, season of sowing, etc. will be recorded

CHARACTERIZATION AND PRELIMINARY EVALUATION DATA

3. SITE DATA

3.1 COUNTRY OF CHARACTERIZATION AND PRELIMINARY EVALUATION

3.2 SITE (RESEARCH INSTITUTE)

3.3 NAME OF PERSON IN CHARGE OF CHARACTERIZATION

3.4 SOWING DATE

3.4.1 Day

3.4.2 Month

3.4.3 Year

3.5 HARVEST DATE

3.5.1 Day

3.5.2 Month

3.5.3 Year

4. PLANT DATA

4.1 VEGETATIVE

4.1.1 Plant growth habit

- 3 Bushy
- 5 Intermediate
- 7 Prostrate

4.1.2 Time of maturity

- 3 Early
- 5 Intermediate
- 7 Late

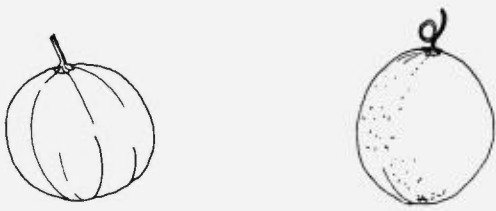
4.2 INFLORESCENCE AND FRUIT

4.2.1 Sex type

To be observed on main stem at first fruit set

- | | <u>Same plant</u> |
|-------------------|---------------------------------------|
| 1 Monoecious | ♂ and ♀ |
| 2 Gynomonoecious | ♂ and ♀ |
| 3 Andromonoecious | ♂ and ♀ |
| 4 Hermaphroditic | ♂ |
| 5 Androecious | ♂ |
| 6 Gynoecious | ♀ |
| 7 Dioecious | ♂ and ♀ flowers on different plant |
| 8 Male sterile | |
| 9 Female sterile | |

1 Globular (round)



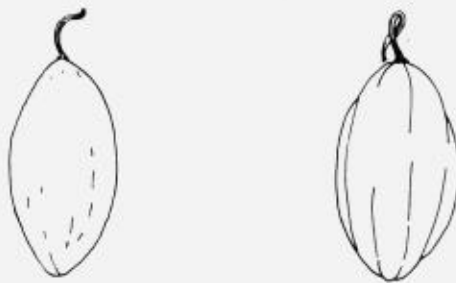
2 Flattened



3 Oblate



4 Elliptical



5 Pyriform

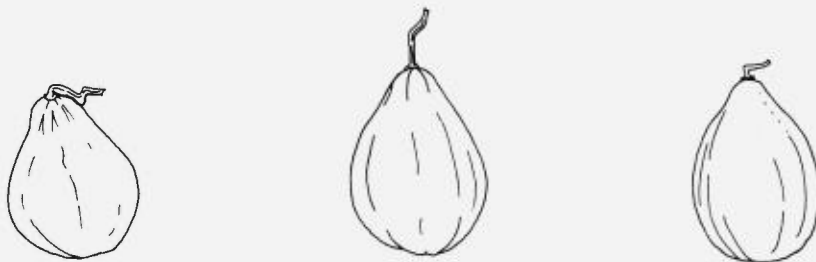
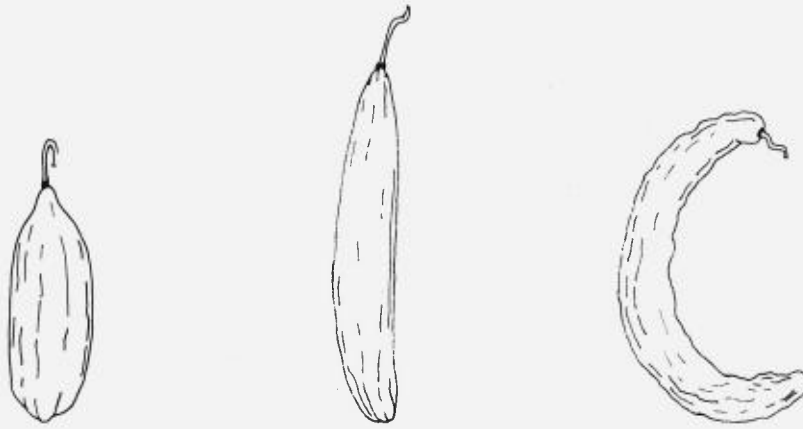


Figure 21. Cucumis melo fruit shape

6 Acorn/Ovate



7 Elongate



G.D.P.

Figure 21. Cucumis melo fruit shape (Cont.)

4.2.2 Ovary pubescence

- 3 Short
- 5 Intermediate (approx. 2 cm)
- 7 Long

4.2.3 Fruit shape

See Figure 21.

- 1 Globular (round)
- 2 Flattened
- 3 Oblate
- 4 Elliptical
- 5 Pyriform
- 6 Acorn/Ovate
- 7 Elongate
- 8 Other (specify in the NOTES descriptor, 11)

4.2.4 Fruit ribs/vein tracks

- 0 Absent
- 3 Superficial
- 5 Intermediate
- 7 Deep

4.2.5 Predominant fruit skin colour at maturity

Predominant colour is the colour which covers the largest surface area of the fruit. In case two colours have the same surface area the lighter colour will be considered the predominant one

- 1 White
- 2 Green
- 3 Blue
- 4 Cream
- 5 Yellow
- 6 Orange
- 7 Red
- 8 Pink
- 9 Brown
- 10 Grey
- 11 Black
- 12 Other (specify in the NOTES descriptor, 11)

4.2.6 Secondary fruit skin colour

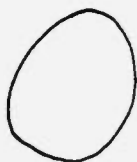
Secondary colour is the colour which covers the second longest area of the fruit. In case two colours have the same surface area the lighter colour will be considered the predominant one

- 0 No secondary skin
- 1 White
- 2 Green
- 3 Blue
- 4 Cream
- 5 Yellow
- 6 Orange
- 7 Red
- 8 Pink
- 9 Other (specify in the NOTES descriptor, 11)

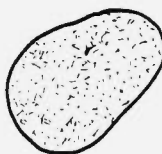
4.2.7 Design produced by secondary skin colour

Speckles are spots less than .5 cm; blotches are spots larger than .5 cm; stripes are bands that run from peduncle to blossom scar; short rays or streaks are elongated marks that are not continuous from one end of the fruit to the other and less than 4 cm in length; long streaks are as above but longer than 4 cm. See Figure 22.

- 0 No secondary skin colour
- 1 Speckled
- 2 Spotted (blotchy)
- 3 Striped
- 4 Streaked
- 5 Other (specify in the NOTES descriptor, 11)



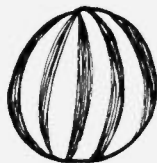
0 No secondary skin colour



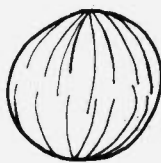
1 Speckled



2 Spotted (blotchy)



3 Striped



4 Streaked

Figure 22. Design produced by secondary skin colour in Cucumis melo

4.2.8 Fruit skin texture

- 1 Smooth
- 2 Grainy
- 3 Finely wrinkled
- 4 Shallowly wavy
- 5 Netted
- 6 With warts
- 7 With spines
- 8 Other (specify in the NOTES descriptor, 11)

4.2.9 Fruit abscision

- 0 No abscision
- 1 Abscises when ripe
- 2 Abscises when over ripe

4.2.10 Blossom scar

- 3 Obscure
- 5 Intermediate
- 7 Conspicuous

4.2.11 Fruit length

To be measured in centimetres at seed harvest maturity

4.2.12 Fruit width

To be measured in centimetres at seed harvest maturity

4.2.13 Fruit weight

In kilograms

4.2.14 Flesh colour

- 1 White
- 2 Green
- 3 Yellow
- 4 Orange
- 5 Salmon

4.2.15 Flesh thickness

To be measured in millimetres at maximum fruit diameter

4.2.16 Flesh texture

- 1 Smooth - firm
- 2 Grainy - firm
- 3 Soft - spongy
- 4 Fibrous - gelatinous
- 5 Fibrous - dry

4.2.17 Colour in one cavity

- 1 White
- 2 Green
- 3 Yellow
- 4 Orange
- 5 Salmon
- 6 Other (specify in the NOTES descriptor, 11)

4.2.18 Soluble solids

Measured in a homogenized sample of flesh and recorded as percentage solids read directly from a Brix Scale superimposed over the refractive index scale

4.3 SEED

4.3.1 Seed coat colour

Colour of seed body excluding the margin

- 0 Seed coat absent
- 1 White
- 2 Tan
- 3 Yellow
- 4 Orange
- 5 Brown
- 6 Grey
- 7 Black

4.3.2 Seed size

In millimetres

- 3 Small (approx. 10 mm)
- 5 Intermediate (approx. 15 mm)
- 7 Large (approx. 20 mm)

FURTHER CHARACTERIZATION AND EVALUATION

5. SITE DATA

5.1 COUNTRY OF FURTHER CHARACTERIZATION AND EVALUATION

5.2 SITE (RESEARCH INSTITUTE)

5.3 NAME OF PERSON IN CHARGE OF EVALUATION

5.4 SOWING DATE

5.4.1 Day

5.4.2 Month

5.4.3 Year

5.5 HARVEST DATA

5.5.1 Day

5.5.2 Month

5.5.3 Year

5.6 DURATION OF VEGETATIVE PERIOD (IN DAYS)

6. PLANT DATA

6.1 VEGETATIVE

6.1.1 Leaf shape

- 1 Ovate
- 2 Orbicular
- 3 Reniform

6.1.2 Leaf lobes

- 0 Absent
- 3 Shallow
- 5 Intermediate
- 7 Deep

6.1.3 Leaf colour

- 3 Light green
- 5 Intermediate
- 7 Dark green

6.1.4 Leaf size

To be compared with that typical for crop type

- 3 Small
- 5 Intermediate
- 7 Large

6.1.5 Leaf pubescence density

- 0 No hairs
- 3 Sparse
- 5 Intermediate
- 7 Dense

6.1.6 Leaf pubescence type

- 3 Soft
- 5 Intermediate
- 7 Hard

6.1.7 Internode length

- 3 Short (approx. 5 cm)
- 5 Intermediate (approx. 10 cm)
- 7 Long (approx. 15 cm)

6.1.8 Tendrils

- 0 Absent
- + Present

6.2 INFLORESCENCE AND FRUIT

6.2.1 Flower colour

- 1 White
- 2 Yellow
- 3 Orange
- 4 Green
- 5 Others (specify in the NOTES descriptor, 11)

- 6.2.2 Ease of peduncle separation from fruit
- 3 Easy
 - 5 Intermediate
 - 7 Difficult
- 6.2.3 Bitterness of immature fruit
- Measured 1-2 weeks after pollination
- 0 No bitterness
 - 3 Low
 - 5 Intermediate
 - 7 High
- 6.2.4 Number of fruits harvested per plant
- Actual number as a mean of 5 plants
- 6.2.5 Fruit size variability
- To be compared with that typical for crop type
- 3 Low
 - 5 Intermediate
 - 7 High
- 6.2.6 Fruit volume
- Specify which method used in the NOTES descriptor, 11)
- 6.2.7 Fruit skin texture intensity
- 3 Superficial
 - 5 Intermediate
 - 7 Pronounced
- 6.2.8 Fruit skin texture distribution
- 3 Partially covers fruit
 - 5 Intermediate
 - 7 Fully covers fruit
- 6.2.9 Fruit skin corking
- 0 Absent
 - 3 Sparse
 - 5 Intermediate
 - 7 Dense
- 6.2.10 Pattern of corking
- 1 Longitudinal
 - 2 Transverse
 - 3 Netted
 - 4 Spotted
- 6.2.11 Fruit splitting
- 3 Superficial
 - 5 Intermediate
 - 7 Deep

- 6.2.12 External aroma (blossom end)
0 Absent
+ Present
- 6.2.13 Skin hardness of fruit
Specify the technique used in the NOTES descriptor, 11)
3 Soft
5 Intermediate
7 Hard
- 6.2.14 Internal aroma
0 Absent
+ Present (specify in the NOTES descriptor, 11)
- 6.2.15 Fruit skin thickness
To be measured in millimetres at maximum fruit diameter
- 6.2.16 Internal colour of skin
1 White
2 Green
3 Yellow
4 Orange
5 Salmon
6 Other (specify in the NOTES descriptor, 11)
- 6.2.17 Cavity diameter
To be measured in millimetres at maximum fruit diameter
- 6.2.18 Flesh colour intensity
3 Light
5 Intermediate
7 Dark
- 6.2.19 Flesh moisture
3 Low
5 Intermediate
7 High
- 6.2.20 Flesh dry matter percent
3 Low (10-15%)
5 Intermediate (20-25%)
7 High (30-35%)
- 6.2.21 Amount of placental tissue
3 Low
5 Intermediate
7 High
- 6.2.22 Ease of seed and placenta separation from flesh
3 Low (difficult)
5 Intermediate
7 High (easy)

6.2.23 Flesh flavour

- 3 Insipid
- 5 Intermediate
- 7 Sweet

6.2.24 Fruit storage ability

- 3 Low (approx. 1 week)
- 5 Intermediate (approx. 1 month)
- 7 High (approx. 3 months)

6.3 SEED

6.3.1 Number of seeds per fruit

Actual number

6.3.2 Seed shape

- 1 Round
- 2 Elliptical
- 3 Oval
- 4 Acorn
- 5 Cone
- 6 Deformed (specify in the NOTES descriptor, 11)

6.3.3 100 seed weight

7. STRESS SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

7.1 LOW TEMPERATURE

7.2 HIGH TEMPERATURE

7.3 DROUGHT

7.4 HIGH SOIL MOISTURE

7.5 HIGH HUMIDITY

7.6 SALINITY

7.7 ACIDITY

8. DISEASE AND PEST SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

8.1 PESTS

- 8.1.1 Acalymma trivittata (Mann.) - Western striped cucumber beetle
- 8.1.2 Anasa tristis (De Geer) - Squash bug
- 8.1.3 Aphis gossypii (Glov.) - Melon aphid
- 8.1.4 Blapstinus spp. - Darkling ground beetle
- 8.1.5 Diabrotica balteata (Lac.) - Banded cucumber beetle
- 8.1.6 D. undecimpunctata (Mann.) - Western spotted cucumber beetle
- 8.1.7 D. undecimpunctata howardi (Barber) - Spotted cucumber beetle
- 8.1.8 D. virgifera - Western corn root worm
- 8.1.9 Empoasca abrupta (De Long) - Leaf hopper
- 8.1.10 E. arida (De Long) - Leaf hopper
- 8.1.11 E. solana (De Long) - Leaf hopper
- 8.1.12 Liriomyza spp. - Leaf miner
- 8.1.13 Meliodogyne spp. - Root-knot nematode
- 8.1.14 Melittia cucurbitae (Harris) - Squash vine borer
- 8.1.15 Myzus persicae (Sulzer) - Green peach aphid
- 8.1.16 Petrobia latens (Muller) - Brown wheat mite
- 8.1.17 Tetranychus atlanticus (McGregor) - Atlantic spider mite
- 8.1.18 T. desertorum Banks - Desert spider mite
- 8.1.19 T. pacificus (McGregor) - Pacific spider mite
- 8.1.20 T. telarius L. - Two spotted spider mite
- 8.1.21 Trialeurodes vaporariorum (Westwood) - White fly
- 8.1.22 Other (specify in the NOTES descriptor, 11)

8.2 FUNGI

- 8.2.1 Alternaria cucumerina (Ell. & Ev.) J.A. Elliot
- 8.2.2 Cercospora melonis (Cke.)
- 8.2.3 Colletotrichum lagenarium (Pass.) - Anthracnose Race 1, Ell & Halls Race I
- 8.2.4 C. lagenarium (Pass.) - Anthracnose Race 2, Ell & Halls Race 2
- 8.2.5 Erysiphe cichoracearum D.C. - Powdery Mildew Race 1, (syn. Sphaerotheca fuliginea)
- 8.2.6 Fusarium solani f. cucurbitae (Synder & Hansen) - Fusarium wilt
- 8.2.7 Mycosphaerella citrullina (C.O. Smith) Gross - Gummy stem blight, (syn. Didymella bryoniae (Anersw.) Rehm.

- 8.2.8 Phyllosticta cucurbitacearum (Sacc.)
- 8.2.9 Pythium irregulare (Buis) - Seedling blight
- 8.2.10 P. ultimum - Seedling blight
- 8.2.11 P. aphanidermatum (Edson) Fitz
- 8.2.12 Phytophthora capsici (Leon)
- 8.2.13 Pseudoperonospora cubensis (Berk & Curt.) Rostow - Downy mildew
- 8.2.14 Rhizoctonia solani (Kuhn) - Seedling blight
- 8.2.15 Septoria cucurbitacearum (Sacc.)
- 8.2.16 Stemphylium cucurbitacearum (Osner)
- 8.2.17 Other (specify in the NOTES descriptor, 11)
- 8.3 BACTERIA
 - 8.3.1 Erwinia tracheiphila (E.F. Sm.) Holland - Bacterial wilt
 - 8.3.2 Other (specify in the NOTES descriptor, 11)
- 8.4 VIRUS
 - 8.4.1 Cucumber mosaic virus
 - 8.4.2 Bean yellow mosaic virus
 - 8.4.3 Melon mosaic virus
 - 8.4.4 Squash mosaic virus
 - 8.4.5 Tobacco ringspot virus
 - 8.4.6 Tomato ringspot virus
 - 8.4.7 Watermelon mosaic virus - Race 1
 - 8.4.8 Watermelon mosaic virus - Race 2
 - 8.4.9 Other (specify in the NOTES descriptor, 11)

9. ALLOENZYME COMPOSITION

This may prove to be a useful tool for identifying duplicate accessions

10. CYTOLOGICAL CHARACTERS AND IDENTIFIED GENES

11. NOTES

Give additional information where descriptor state is noted as 'Other' as, for example, in descriptor 8.4.9, etc. Also include here any further relevant information

Descriptor list for Cucumis sativus

PASSPORT

1. ACCESSION DATA

1.1 ACCESSION NUMBER

This number serves as a unique identifier for accessions and is assigned by the curator when an accession is entered into his collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. Letters should occur before the number to identify the genebank or national system (e.g. MG indicates an accession comes from the genebank at Bari, Italy, PI indicates an accession within the USA system).

1.2 DONOR NAME

Name of institution or individual responsible for donating the germplasm.

1.3 DONOR IDENTIFICATION NUMBER

Number assigned to accession by the donor

1.4 OTHER NUMBERS ASSOCIATED WITH THE ACCESSION (other numbers can be added as 1.4.3 etc.)

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not collection number, see 2.1)

1.4.1 Other number 1

1.4.2 Other number 2

1.5 SCIENTIFIC NAME

1.5.1 Genus

1.5.2 Species

1.5.3 Subspecies

1.6 PEDIGREE/CULTIVAR NAME

Nomenclature and designations assigned to breeder's material

1.7 ACQUISITION DATE

The month and year in which the accession entered the collection, expressed numerically, e.g. June = 06, 1981 = 81

1.7.1 Month

1.7.2 Year

1.8 DATE OF LAST REGENERATION OR MULTIPLICATION

The month and year expressed numerically, e.g. October = 10, 1978 = 78

1.8.1 Month

1.8.2 Year

1.9 ACCESSION SIZE

Approximate number of seeds of accession in collection

1.10 NUMBER OF TIMES ACCESSION REGENERATED

Number of regenerations or multiplications since original collection

1.11 TYPE OF MAINTENANCE

- 1 Vegetative
- 2 Seed
- 3 Both
- 4 Tissue culture

2. COLLECTION DATA

2.1 COLLECTOR'S NUMBER

Original number assigned by collector of the sample normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections and should always accompany sub-samples wherever they are sent

2.2 COLLECTING INSTITUTE

Institute of person collecting/sponsoring the original sample

2.3 DATE OF COLLECTION OF ORIGINAL SAMPLE

Expressed numerically, e.g. March = 03, 1980 = 80

2.3.1 Month

2.3.2 Year

2.4 COUNTRY OF COLLECTION OR COUNTRY WHERE CULTIVAR/VARIETY BRED

Use the three letter abbreviations supported by the Statistical Office of the United Nations. Copies of these abbreviations are available from the IBPGR Secretariat and have been published in the FAO/IBPGR Plant Genetic Resources Newsletter number 49

2.5 PROVINCE/STATE

Name of the administrative subdivision of the country in which the sample was collected

2.6 LOCATION OF COLLECTION SITE

Number of kilometres and direction from nearest town, village or map grid reference (e.g. TIMBUKTU7S means 7 km south of Timbuktu)

2.7 LATITUDE OF COLLECTION SITE

Degrees and minutes followed by N (north) or S (south), e.g. 1030S

2.8 LONGITUDE OF COLLECTION SITE

Degrees and minutes followed by E (east) or W (west), e.g. 7625W

2.9 ALTITUDE OF COLLECTION SITE

Elevation above sea level in metres

2.10 COLLECTION SOURCE

- 1 Wild
- 2 Farm land
- 3 Farm store
- 4 Backyard
- 5 Village market
- 6 Commercial market
- 7 Institute
- 8 Other (specify in the NOTES descriptor, 11)

2.11 STATUS OF SAMPLE

- 1 Wild
- 2 Weedy
- 3 Breeders line
- 4 Primitive cultivar (landrace)
- 5 Advanced cultivar (bred)
- 6 Other (specify in the NOTES descriptor, 11)

2.12 LOCAL/VERNACULAR NAME

Name given by farmer to cultivar/landrace/weed

2.13 NUMBER OF PLANTS SAMPLED

Approximate number of plants collected in the field to produce this accession

2.14 PHOTOGRAPH

Was a photograph taken of the accession or environment at collection? If photo has been taken, provide any identification number/system in the NOTES descriptor, 11

- 0 No
+ Yes

2.15 TYPE OF SAMPLE

- 1 Vegetative
- 2 Seed
- 3 Both

2.16 HERBARIUM SPECIMEN

Was a herbarium specimen collected?

- 0 No
+ Yes

2.17 OTHER NOTES FROM COLLECTOR

Collectors will record ecological information. For cultivated crops, cultivation practices such as irrigation, season of sowing, etc. will be recorded

CHARACTERIZATION AND PRELIMINARY EVALUATION DATA

3. SITE DATA

3.1 COUNTRY OF CHARACTERIZATION AND PRELIMINARY EVALUATION

3.2 SITE (RESEARCH INSTITUTE)

3.3 NAME OF PERSON IN CHARGE OF CHARACTERIZATION

3.4 SOWING DATE

3.4.1 Day

3.4.2 Month

3.4.3 Year

3.5 HARVEST DATE

3.5.1 Day

3.5.2 Month

3.5.3 Year

4. PLANT DATA

4.1 VEGETATIVE

4.1.1 Plant growth habit

3 Bushy

5 Intermediate

7 Prostrate

4.1.2 Time of maturity

3 Early

5 Intermediate

7 Late

4.2 INFLORESCENCE AND FRUIT

4.2.1 Sex type

To be observed on main stem at first fruit set

| | <u>Same plant</u> |
|-------------------|--|
| 1 Monoecious | ♂ and ♀ |
| 2 Gynomonoecious | ♀ and ♀ |
| 3 Andromonoecious | ♀ and ♂ |
| 4 Hermaphroditic | ♀ |
| 5 Androecious | ♂ |
| 6 Gynoecious | ♀ |
| 7 Dioecious | ♂ and ♀ flowers on different plants |
| 8 Male sterile | |
| 9 Female sterile | |

4.2.2 Fruit shape

See Figure 23.

- 1 Elliptical elongate
- 2 Oblong ellipsoid
- 3 Globular (round)
- 4 Stem end tapered
- 5 Blossom end tapered

4.2.3 Fruit stem colour

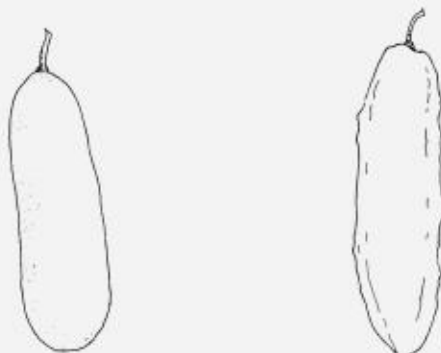
To be obtained at table use maturity

- 1 White
- 2 Light green
- 3 Medium green
- 4 Dark green
- 5 Yellow
- 6 Other (specify in the NOTES descriptor, 11)

4.2.4 Fruit skin mottling

- 0 Absent
- + Present

1 Elliptical elongate



2 Oblong ellipsoid



Figure 23. Cucumis sativus fruit shape

3 Globular (round)



4 Stem-end tapered



5 Blossom-end tapered



G.D.P.

Figure 23. Cucumis sativus fruit shape (Cont.)

4.2.5 Stripes on blossom-end of fruit

- 0 Absent
- 3 Less than 1/3 of fruit length
- 5 Approx. 1/2 of fruit length
- 7 More than 2/3 of fruit length

4.2.6 Colour of stripes

- 0 Absent
- 1 White
- 2 Green
- 3 Yellow
- 4 Other (specify in the NOTES descriptor, 11)

4.2.7 Fruit spine colour

- 0 Spines absent
- 1 Black
- 2 Brown
- 3 White
- 4 Other (specify in the NOTES descriptor, 11)

4.2.8 Fruit skin glossiness

- 1 Dull
- 2 Glossy

4.2.9 Fruit skin texture

- 1 Smooth
- 2 Wrinkled
- 3 Netted
- 4 Tubercules
- 5 Other (specify in the NOTES descriptor, 11)

4.2.10 Intensity of bitterness in flesh

- 0 Not bitter
- 3 Low
- 5 Intermediate
- 7 High

4.2.11 Fruit length

To be measured in centimetres at seed harvest maturity

4.2.12 Fruit width

To be measured in centimetres at seed harvest maturity

4.2.13 Fruit colour

To be observed at seed harvest maturity

- 1 White
- 2 Green
- 3 Yellow
- 4 Orange
- 5 Red
- 6 Brown
- 7 Other (specify in the NOTES descriptor, 11)

4.3 SEED

4.3.1 Number of seeds per fruit

Give actual number as a mean of 5 randomly selected samples

FURTHER CHARACTERIZATION AND EVALUATION

5. SITE DATA

5.1 COUNTRY OF FURTHER CHARACTERIZATION AND EVALUATION

5.2 SITE (RESEARCH INSTITUTE)

5.3 NAME OF PERSON IN CHARGE OF EVALUATION

5.4 SOWING DATE

5.4.1 Day

5.4.2 Month

5.4.3 Year

5.5 HARVEST DATA

5.5.1 Day

5.5.2 Month

5.5.3 Year

5.6 DURATION OF VEGETATIVE PERIOD (IN DAYS)

6. PLANT DATA

6.1 VEGETATIVE

6.1.1 Germination percentage at low temperature

- 3 Low
- 5 Intermediate
- 7 High

6.1.2 Leaf size

- 3 Small
- 5 Intermediate
- 7 Large

6.1.3 Leaf pubescence density

- 0 No hairs
- 3 Sparse
- 5 Intermediate
- 7 Dense

6.1.4 Internode length

- 3 Short (approx. 5 cm)
- 5 Intermediate (approx. 10 cm)
- 7 Long (approx. 15 cm)

6.1.5 Tendrils

- 0 Absent
- + Present

6.2 INFORESCENCE AND FRUIT

6.2.1 Flower colour

- 1 White
- 2 Yellow
- 3 Orange
- 4 Green
- 5 Other (specify in the NOTES descriptor, 11)

6.2.2 Parthenocarpy

Not to be observed earlier than table use maturity

- 0 Absent
- + Present

6.2.3 Locule number

6.2.4 Stem-end fruit shape

To be observed at the stem-end. See Figure 24

- 1 Depressed
- 3 Flattened
- 5 Rounded
- 7 Pointed



1 Depressed



3 Flattened



5 Rounded



7 Pointed

Figure 24. Cucumis sativus stem-end fruit shape



Figure 25 Cucumis sativus blossom-end fruit shape

6.2.5 Blossom-end fruit shape

To be observed at the blossom-end. See Figure 25.

- 1 Depressed
- 3 Flattened
- 5 Rounded
- 7 Pointed

6.2.6 Fruit skin texture intensity

- 3 Superficial
- 5 Intermediate
- 7 Pronounced

6.2.7 Fruit skin hardness

- 3 Soft - easily marked by fingernail
- 5 Intermediate - difficult to mark with fingernail
- 7 Hard - impossible to mark with fingernail

6.2.8 Fruit length at table use maturity

In centimetres

6.2.9 Fruit width at table use maturity

In millimetres

6.2.10 Fruit size variability

To be compared with that typical for crop type

- 3 Low
- 5 Intermediate
- 7 High

6.2.11 Flesh thickness

In millimetres

6.2.12 Flesh texture

- 1 Smooth - firm
- 2 Grainy - firm
- 3 Soft
- 4 Fibrous
- 5 Other (specify in the NOTES descriptor, 11)

6.2.13 Flesh colour

- 1 White
- 2 Green
- 3 Yellow
- 4 Orange
- 5 Other (specify in the NOTES descriptor, 11)

6.2.14 Fruit storage ability

Without refrigeration

- 3 Low
- 5 Intermediate
- 7 High

6.3 SEED

6.3.1 Seed coat colour

Observed on mature seed

- 1 White
- 2 Tan
- 3 Yellow
- 4 Orange
- 5 Brown

6.3.2 Seed size

- 3 Small (approx. 1.0 cm)
- 5 Intermediate (approx. 1.5 cm)
- 7 Large (approx. 2.0 cm)

6.3.3 1000 seed weight

Average weight of two samples of 1000 randomly chosen seeds measured in grams

7. STRESS SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

- 7.1 LOW TEMPERATURE
- 7.2 HIGH TEMPERATURE
- 7.3 DROUGHT
- 7.4 HIGH SOIL MOISTURE
- 7.5 HIGH HUMIDITY
- 7.6 SALINITY
- 7.7 ACIDITY

8. DISEASE AND PEST SUSCEPTIBILITY

Scored on a 1-9 scale where

- 3 Low susceptibility
- 5 Medium susceptibility
- 7 High susceptibility

- 8.1 PESTS
 - 8.1.1 Acalymma trivittata (Mann.) - Western striped cucumber beetle
 - 8.1.2 Anasa tristis (De Geer) - Squash bug
 - 8.1.3 Aphis gossypii (Glov.) - Melon aphid
 - 8.1.4 Blapstinus spp. - Darkling ground beetle
 - 8.1.5 Diabrotica balteata (Lac.) - Banded cucumber beetle
 - 8.1.6 D. undecimpunctata (Mann.) - Western spotted cucumber beetle
 - 8.1.7 D. undecimpunctata howardi (Barber) - Spotted cucumber beetle
 - 8.1.8 D. virgifera - Western corn root worm
 - 8.1.9 Empoasca abrupta (De Long) - Leaf hopper
 - 8.1.10 E. arida (De Long) - Leaf hopper
 - 8.1.11 E. solana (De Long) - Leaf hopper
 - 8.1.12 Liriomyza spp. - Leaf minor
 - 8.1.13 Melioidogyne spp. - Root-knot nematode
 - 8.1.14 Melittia cucurbitae (Harris) - Squash vine borer
 - 8.1.15 Myzus persicae (Sulzer) - Green peach aphid
 - 8.1.16 Petrobia latens (Muller) - Brown wheat mite

- 8.1.17 Tetranychus atlanticus (McGregor) - Atlantic spider mite
 - 8.1.18 T. desertorum Banks - Desert spider mite
 - 8.1.19 T. pacificus (McGregor) - Pacific spider mite
 - 8.1.20 T. telarius L. - Two spotted spider mite
 - 8.1.21 Trialeurodes vaporariorum (Westwood) - White fly
 - 8.1.22 Other (specify in the NOTES descriptor, 11)
- 8.2 FUNGI
- 8.2.1 Alternaria cucumerina (Ell. & Ev.) J.A. Elliot
 - 8.2.2 Cercospora melonis (Cke.)
 - 8.2.3 Colletotrichum lagenarium (Pass.) - Anthracnose Race 1, Ell & Halls Race I
 - 8.2.4 C. lagenaria (Pass.) - Anthracnose Race 2, Ell & Halls Race 2
 - 8.2.5 Erysiphe cichoracearum D.C. - Powdery Mildew Race 1, (syn. Sphaerotheca fuliginea)
 - 8.2.6 Fusarium solani f. cucurbitae (Synder & Hansen) - Fusarium wilt
 - 8.2.7 Mycosphaerella citrullina (C.O. Smith) Gross - Gummy stem blight, (syn. Didymella bryoniae (Anersw.) Rehm.
 - 8.2.8 Phyllosticta cucurbitacearum (Sacc.)
 - 8.2.9 Pythium irregulare (Buis) - Seedling blight
 - 8.2.10 P. ultimum - Seedling blight
 - 8.2.11 P. aphanidermatum (Edson) Fitz
 - 8.2.12 Phytophthora capsici (Leon)
 - 8.2.13 Pseudoperonospora cubensis (Berk & Curt.) Rostow - Downy mildew
 - 8.2.14 Rhizoctonia solani (Kuhn) - Seedling blight
 - 8.2.15 Septoria cucurbitacearum (Sacc.)
 - 8.2.16 Stemphylium cucurbitacearum (Osner)
 - 8.2.17 Other (specify in the NOTES descriptor, 11)
- 8.3 BACTERIA
- 8.3.1 Erwinia tracheiphila (E.F. Sm.) Holland - Bacterial wilt
 - 8.3.2 Other (specify in the NOTES descriptor, 11)

8.4 VIRUS

8.4.1 Cucumber mosaic virus

8.4.2 Bean yellow mosaic virus

8.4.3 Melon mosaic virus

8.4.4 Squash mosaic virus

8.4.5 Tobacco ringspot virus

8.4.6 Tomato ringspot virus

8.4.7 Watermelon mosaic virus - Race 1

8.4.8 Watermelon mosaic virus - Race 2

8.4.9 Other (specify in the NOTES descriptor, 11)

9. ALLOENZYME COMPOSITION

This may prove to be a useful tool for identifying duplicate accessions

10. CYTOLOGICAL CHARACTERS AND IDENTIFIED GENES

11. NOTES

Give additional information where descriptor state is noted as 'Other' as, for example, in descriptor 8.4.9, etc. Also include here any further relevant information

